NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, NOVEMBER 5, 1896.

THE PHILOSOPHY OF NATURAL SCIENCE.

Studien zu Methodenlehre und Erkenntnisskritik. Von Friedrich Dreyer. Pp. viii + 223. (Leipzig: Engelmann, 1895.)

Erkenntnistheoretische Grundzüge der Naturwissenschaften und ihre Beziehungen zum Geistesleben der Gegenwart. Allgemein wissenschaftliche Vorträge. Von Dr. P. Volkmann. Pp. xii + 181. (Leipzig: Teubner, 1896.)

IF we were to examine these two works purely from the standpoint of the critical reviewer, we should probably content ourselves by recommending the busy man of science to pass them by. We might, indeed, justify the sternness of our judgment by illustrating the hopelessly involved style of Herr Dreyer—his page-long footnotes on footnotes, his misinterpretations of mathematical and physical theories, and his obvious, but nowhere justified, bias against Darwinism. We might then pass to Dr. Volkmann and show the vagueness of his definitions, the unphilosophical character of his epistemology, and indicate the danger which arises when loose analogies drawn from natural science are applied to other fields of thought. We might not unreasonably conclude with a sigh over the departing glory of German science. We might moan over the death or old age of the giants of a quarter of a century back, and regret that the strong and clear intellects of young Germany seem drawn rather to military and commercial pursuits than to the service of science. That Germany has become the first military, and is rapidly becoming the first commercial nation, are now familiar ideas; but that these victories have been won at the expense of literature and pure science, is an aspect of evolution which other nations are only just beginning to realise, and Germany herself will only realise last of all. It is a subtle qualitative, not a quantitative change which has been going on since 1870 in German science and literature. Few realise it, but it is none the less a reality. It is, perhaps, as well that leadership in all spheres should not fall to one people. From the historical stand-point accordingly, these two books are of interest, for they are very typical of much work which Germany has of recent years put forth. Their authors fully recognise that there are great problems still unsolved in the philosophical basis of the natural sciences, but it cannot be said that they throw any light on the solution of these problems, nay, that they even assist us in their clear enunciation. Herr Dreyer indeed tells us with much truth that:

> "Auf dem Gebiete der Biologie sieht es noch recht wild und windig aus";

but his lengthy defence of "vital force" is hardly calculated to bring more system into biological thought.

Prof. Volkmann is evidently not quite at his ease in his endeavours to define such fundamental concepts as "natural law" and "physical hypothesis." Yet for him natural laws like the law of gravitation lie outside us while the conclusions of mathematics are thought-laws which lie inside us:

> "Diese Naturnothwendigkeiten ausser uns nirgends in Widerspruch treten mit den Denknothwendigkeiten in uns."

This arises apparently from a pre-established harmony the source of which is accounted for in a manner which the writer tells us is the "Kernpunkt meiner erkenntnistheoretischen Studien auf naturwissenschaftlichem Boden." It lies namely in this:

> "dass die Logik in uns ihren Ursprung in dem gesetzmässigen Geschehen der Dinge ausser uns hat, dass die äussere Nothwendigkeit des Naturgeschehens unsere erste und recht eigentliche Lehrmeisterin ist."

We are only given this sentence, without *one* word more description of the process by which such harmony has been established! A poet might have thrown out the idea, but put thus in a scientific treatise it is hardly calculated to help us in clearing up our fundamental notions.

It would, however, be wrong to merely smile over what we feel compelled to term trivialities, or to think that they are solely characteristic of German naturalists. A very superficial study of current English physical and dynamical text-books will suffice to demonstrate how much we ourselves need a thorough *Aufklärung* in our

fundamental physical ideas. A mere perusal of current discussions on variation, correlation, panmixia, will avail to show how "right wild and windy" it is in the field of English biology also. This is the second stand-point from which a consideration of the ideas of Dreyer and Volkmann may be of value. Their books may help us to realise the condition of affairs at home, and if we do that we shall hardly find much ground for national self-congratulation.

During the last ten or fifteen years a very great revolution has been more or less silently taking place in the philosophical theory of men of science. The revolution is very far from being complete, for old theories are hard to dissolve when they have crystallised into dogmas. The chaotic definitions of the text-books, the chaotic thinking of too many biological controversialists, are all signs of a transition period, of new ideas struggling with old modes of expression, with an antique terminology suited to a scientific philosophy no longer capable of satisfying modern intellectual needs. But whether we turn to Germany, to France, or to our own country, and study the literature which touches on the *erkenntnistheoretische* foundations of science, we shall alike be forced to the conclusion that a revolution in scientific thought has been taking place, and that in the minds of the more philosophical men of science, it is already complete. There are many ways of summing up the purport of this revolution. Perhaps the shortest, if not the most expressive, is to say that the old division of science into exact and descriptive sciences is now seen to be illusory. The immense progress made in the first half of this century with theoretical mechanics, the success with which mechanical reasoning was applied in the third quarter of the century to the great physical discoveries of that period, led men of science not unnaturally to postulate mechanism as the basis of all natural processes whatsoever. Particles, molecules, atoms, impacts, vibrations, laws of forces were the forms under which all nature worked, and by which all things were to be *explained*. The dogma that mechanism would explain the universe may have been philosophically absurd, but by concentrating men's thoughts on one method of investigation, it led to a whole round of splendid discoveries. For all but the great leaders of science work under any theory, under any dogma indeed, which has produced and is still capable of producing great results, is far better than the invention of new hypotheses. Fruitful new hypotheses have almost always been the product of master-minds, which have worked out old theories to the point at which they are seen to absolutely contradict phenomena. The 'prentice hand finding some new fact at present unaccounted for by the old-established theory is generally over-hasty with the fabrication of a new hypothesis. The true criterion for the modification or rejection of an established theory which has produced sound scientific results is not its present insufficiency to account for this or that isolated group of phenomena—its insufficiency may arise from the weakness of our analysis, or from want of insight in our application of it—the criterion lies rather in a demonstrable contradiction between the theory and some particular class of phenomena. The existence of such a contradiction can only be satisfactorily proven by a master with the firmest grasp of theory and the fullest appreciation of natural facts. Had the necessity for such a criterion been borne in mind, the field of biology would possibly not now look so "wild and windy." Has there not been a far too ready invention of new hypotheses—on the ground that the theory of natural selection combined with heredity has not hitherto provided a satisfactory account of certain phenomena—while, as a matter of fact, the modification or rejection of such a fruitful theory ought to be solely based on the absolute contradiction of its deductions by our experience of nature?

The whole point is, indeed, well illustrated by Herr Dreyer's onslaught on "die moderne Entwicklungslehre mit ihrem famosen Darwinismus," which "noch so kannibalisch wohl fühlt." It is perfectly easy to show that neither Darwinism[1] nor mechanism in their respective spheres have accounted for anything but a small fringe of organic phenomena. It is quite easy to postulate the possibility of other evolutionary hypotheses and of "vital forces," which in the future may render account of other ranges of phenomena. But take, for example, such a concept as "vital force"—the definition of which is so obscure that it is impossible to assert or deny its existence—and ask what fruitful results it has contributed to biology as compared with what has been achieved by an application of mechanical theory—under which term we should include chemico-physical laws? Herr Dreyer is very stern with Otto Liebmann for ridiculing "vital force"; but when we come to investigate what Herr Dreyer himself understands by "vital force," it appears to be embraced in a *Lebensgesetzlichkeit*, which shall be coordinate with, and not superior to the *physikalische Gesetzlichkeit*. The study of this *Lebensgesetzlichkeit* is to form the science of *Vitalistik*. It would be interesting to know who has been so rash as to deny the existence of yet undiscovered laws of life, which are not identical, but coordinate with already established physical laws. Herr Dreyer's position may be thus summed up: It is not proven that physics can lead us everywhere in the organic field, let us try the fabrication of new hypotheses and build up a new science of vitalistics.

Well, and good! A master-mind may some day propound an hypothesis of value; we should have preferred the statement of single new *Lebensgesetz* to all Herr Dreyer's discussion on *Lebensgesetzlichkeit*. We hold that for the every-day man of science it is better to work a by-no-means exhausted vein of ore, than rush off to the still unworked, but highly-puffed field of vitalistics. Science as well as commerce has its gold reefs—without gold. Nor was the attack of the *so kannibalisch wohl fühlende moderne Entwicklungsmänner* on *Lebenskraft* without its justification. That term embraced an unscientific attempt to slur over ignorance, and encouraged loose thinking by stealing from mechanics in the word "force" some of the clearness and definiteness of mechanical concepts. That no knowledge of *Lebensgesetzlichkeit* came out of its use, can we think be historically proven, nor are we, indeed, prepared to admit that it even acted for a time as a successful bulwark against a materialistic view of

[1] By "Darwinism" may here be broadly understood the theory which supposes evolution to have taken place by natural selection combined with heredity.

life. The materialistic view of life—the theory which would *explain* all organic and inorganic nature by force and matter—has disappeared owing to a wider and more philosophic view of mechanism, and not to the logic of vitalists. It is the physicists, and not the biologists, who have broken down the barrier between the exact and descriptive sciences, and among whom a truer view of mechanism has arisen. The biologists have been only too ready to offer "explanations" of various organic processes by appeal to molecules, centres of force and energies. While they have been attempting a mechanical basis for descriptive science, the physicists have learnt that mechanics, after all, is but a descriptive science itself. "The object of mechanics is to *describe* in the simplest possible fashion the motions which occur in nature." Such was Kirchhoff's definition, and the acceptance of that definition is really the revolution which has been going on in natural science. It is a revolution which cuts at the idea of force as a cause, but sees in it only a measure of change; it is a revolution which thrusts upon us the agnostic position of watching and describing, and which drops *explanation* out of the scientific glossary or defines its old sense entirely away. It is a revolution which again renders for us the motion of a planet every whit as mysterious as the oscillations of protoplasm. We can explain neither, although long study and observation have enabled us to describe one motion in much simpler terms than the other.

Mechanism as the description in the simplest possible terms, not the explanation, of natural motions is a revolutionary definition which at once reduces all physics, chemistry and biology to the same simple footing. In all three sciences it is the sequence of changes in space and time that we endeavour to describe in the simplest language. In doing this, we are inevitably thrown back on geometry and kinematics. The conceptions of these sciences are not identical with real experience; they are based on ideal forms and ideal ratios drawn as limits from our experience of phenomena. But it is in terms of these only that we succeed in describing change, and this geometrical and kinematic description of change, and of repeated sequences of change is what we are to understand by mechanism in its broadest sense. It is this mechanism, which embraces such inventions of the intellect as particles, molecules, atoms and ethers, and describes kinematically, or in terms of the motions it attributes to them, physical phenomena. Organic phenomena may require to be described by other conceptual elements having other modes of motion attributed to them than those which have hitherto been adopted in physical descriptions. But if organic phenomena are to be described scientifically, it must be by a series of symbolic forms moving in time and space. In this sense biology must ultimately become a mechanical science. This does not mean that life can be "explained" by mechanism—on the contrary, mechanism explains nothing, not even physical nature—but that the bulk of natural science is a description of change, of motion in time and space, and that the invention of comprehensive and brief formulæ of motion is the function of mechanics. In this sense it seems impossible to contrast mechanism and "vital force," or to maintain any rigid line of demarcation between the physical and descriptive sciences.

From this standpoint, which we believe to be the firm ground, soon to be left behind by the sea of current *erkenntnistheoretische* controversies, how purely idle does Prof. Volkmann's disquisition on natural laws, rules, hypotheses, and axioms appear! Thus Newton's law of gravitation, the principle of energy, Galilei's law of inertia, he tells us, are *Naturgesetze;* Kepler's laws of planetary motion are merely *Regeln*, and the undulatory theory of light an *Hypothese!* Yet Prof. Volkmann's definitions are worth noticing, because they show us so very clearly the present transitional state of scientific thought.

"Das Naturgesetz bildet den kürzesten und zugleich reichhaltigsten Ausdruck für das, was thatsächlich geschieht und zwar was ausnahmslos geschieht, was geschehen muss" (p. 58).

It is the *sinnliche Wahrnehmung* which changes the *Hypothese* to the *Naturgesetz*. But we must ask, what physicist ever caught a particle, or had a *sinnliche Wahrnehmung* of how two particles, if caught, would attract each other? How is Newton's particle more real than the atom of the chemist? Even Dr. Volkmann admits that the conception of the atom as something *bildlich symbolisch*, is to-day winning ground everywhere. How can we have *sinnliche Wahrnehmung* of the law of inertia? Does it not require the most ideal conceptions of relative motion and of "fixed axes" to at all realise its meaning; and is it then more than a definition of acceleration? We cannot find this law *so einleuchtend* and *so unmittelbar* as Dr. Volkmann believes, nor consider that its essence can be scientifically illustrated by the motion of a locomotive over smooth rails, when the steam is cut off. Indeed our author skates somewhat lightly over the abysmal gulf of the relativity of all motion. He has given up force as a reality, but the influence of relativity on all forms of kinetic energy does not appear to have struck him, and, like many another physicist, he would probably suppose we had some *sinnliche Wahrnehmung* of the absolute in a quantum of energy. The undulatory theory of light was purely hypothesis so long as it was *übersinnliche Anschauung und Vorstellung;* but now that the young German physicist Wiener has photographed light waves, we are told, that it has ceased to be an hypothesis, it has become *eine vollendete Thatsache!*—a law of nature. In not one of such natural laws, however, is there anything of the *muss* of Prof. Volkmann's definition. They are purely *bildlich symbolisch* descriptions of motion, more or less simple, more or less complete and satisfactory.

The reader will notice at once how far many students of science are yet from using the language and appreciating the ideas involved in Kirchhoff's definition of mechanism. Mechanism, whether it be that of the particle, the atom, the ether, or the cell, is a description of motion in the simplest terms the mind can invent, and this description is always in terms of those *bildlich symbolische* elements, which we construct from such ideal sciences as geometry and kinematics. We may attach constants to these elements to be determined by experience, and to be termed charges, masses, &c., and, perhaps, in the distant future, when the science of vitalistics is complete, vital units; but the elements none the less remain *bildlich symbolisch*. They are mental constructs, by which the scientific mind

endeavours to describe its past and predict its future experience in the briefest possible terms. It is this creation of *Naturgesetze* by the mind, this invention of brief formulæ, which is at once the glory and limitation of science. The mind does not explain for us what the world of *Dinge an sich*, which we term nature, may be in and for itself; it seeks with all its ingenuity to describe *bildlich symbolisch*, what falls within the limits of its experience. The progress of science lies in the increasing comprehensiveness and brevity of its descriptions.

Prof. Volkmann tells us that:

"So lange die Naturwissenschaften mit einem inneren Verhältnis zwischen Geist und Natur arbeiteten, war ihr Fortschritt gehemmt" (p. 123).

If this were true, then must natural science and the discovery, or rather *invention* of natural law be for ever retarded, for science must always work at this very relation between mind and nature. It is, however, not the right but the wrong appreciation of the relation of mind to nature which checks scientific progress. The completion of the revolution we have hinted at in this review, so far from being detrimental to natural science, will go a long way towards freeing its workers from the attacks which have been made upon science from more than one quarter, and which have largely arisen from a confusion of the idea of mechanism with some form of materialistic theory. Released from the need of replying to external criticism and attack, science will have the more energy and leisure to progress quietly in its own proper field.

KARL PEARSON.

OUR BOOK SHELF.

Text-Book of Comparative Anatomy. By Dr. Arnold Lang. Translated into English by Henry M. and Matilda Bernard. Part ii. (London: Macmillan and Co., Ltd., 1896.)

THIS volume of Dr. Lang's text-book treats of the Mollusca, Echinodermata, and Enteropneusta. To the first group of animals 283 pages are devoted, and to the latter two 319. The complete and systematic manner in which the structure and relations of the different families and orders described in this work are dealt with, renders each of the three chapters, into which the book is divided, a valuable monograph. Regarding the phylogeny of the Enteropneusta, Dr. Lang states that they "are not closely related to any single large division of the animal kingdom"; his treatment of them in this volume is sufficient evidence that he is not inclined to attach much weight to their supposed affinities with the Chordata. In a short notice it is quite impossible to give any idea of the interesting way in which the book is written. The English translation is all that could be desired; the illustrations are excellent. The arrangement of the subject-matter has been carefully thought out, and reference to any subject is assisted by the use of different kinds of type in the text. A long classified list of the important literature is given at the end of each chapter.

Experience: a Chapter of Prolegomena. By the Rev. Wilfrid Richmond. Pp. iv + 64. (London: Swan Sonnenschein and Co., Ltd., 1896.)

ACCORDING to the author, the initial obstacle to the progress of philosophy is the doctrine that experience cannot give the knowledge of reality—that nothing can be definitely known. This view he demolishes by showing that reality is actually to be found within the field of experience, whence the sensible conclusion is arrived at that "experience is the beginning and end of philosophy."

LETTERS TO THE EDITOR.

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Islandic Earthquake Recorded at Paris.

LE No. de NATURE du 15 octobre contient une note très intéressante de Dr. J. Stefansson, sur le tremblement de terre survenu en Islande le 26 août dernier.

J'ai l'honneur de vous informer que les courbes relevées, à cette date, au magnétographe de l'Observatoire du Parc Saint-Maur, portent nettement la trace de trois troubles particuliers, paraissant se rattacher à ce phénomène. Le premier s'est produit à 11h. 36m., et les deux autres, qui sont plus accentués, respectivement à 11h. 42m. et 11h. 46m. du soir, temps moyen de Paris.

TH. MOUREAUX.

Observatoire du Parc Saint-Maur, le 29 octobre.

Earth Tremors at Edinburgh between August 25 and September 6.

IN connection with Dr. J. Stefansson's article in NATURE of October 15, on the "Recent Earthquakes in Iceland," it may be of some interest to note that the photo-recording bifilar pendulum, presented to this Observatory by M. d'Abbadie, and placed under my care by Prof. Copeland, exhibits on the dates given by Dr. Stefansson several strongly marked irregularities in the curve, which may possibly have had their origin in the Icelandic disturbances. The following table contains a list of all the pendulum oscillations recorded on the photographs between August 25 and September 6, with the Greenwich Mean Times of their occurrence.

	Earthquakes in Iceland.	Edinburgh pendulum oscillations. Begin.	Edinburgh pendulum oscillations. End.	Tilt of pendulum frame.	
Aug. 25		9.25 a.m.	?	″0·4	Slight.
,,		4.45 p.m.	5.50 p.m.	0·6	Slight.
26		9.10 a.m.	11.5 a.m.	0·4	Very slight.
,,		0.55 p.m.	2.10 p.m.	1·0	Slight, but well-marked.
,,	10.30 p.m.	11.10 p.m.	11.30 p.m.	About 2	Gap.
27		6.35 a.m.	?	1·25	Well-marked.
,,	9 15 a.m.	10.50 a.m.	11.5 a.m.	About 2	Gap.
,,		4.10 p.m.	5.40 p.m.	0·5	Very slight.
29		11.20 a.m.			Several almost imperceptible tremors at irregular intervals.
30			4.30 p.m.		
30		4.30 p.m.			No trace of disturbance, but record not complete.
Sept. 4			4.50 p.m.		
4		4.50 p.m.			Photographic trace a perfectly straight line.
6			0.5 a.m.		
5–6	11.30 p.m.	0.5 a.m.	0.20 a.m.	2 to 3	Gap.
6	2 a.m.	No dis	turbance	here.	
,,		9.5 a.m.	?	1·0	Well-marked oscillation.

The points of special interest in this table are the three violent oscillations which have been designated gaps. These are complete interruptions in the curve, caused apparently by successive waves of sufficient amplitude to produce so rapid an oscillatory motion of the pendulum, that the reflected ray traverses the exposing slit too quickly to leave any photographic trace. The result as seen on the photograph is an abrupt termination to the curve line; then for a period of from five to ten minutes no photographic effect whatever is produced, and for about a similar period, a widened and badly defined trace shows that the ray has oscillated to each side of its normal position, with an amplitude of disturbance at the time when the trace begins to reappear of fully 2″, but which must have been considerably greater at the beginning of the gap, where the record is altogether wanting. After this the mirror comes to rest, and the ordinary trace reappears.

In the case of all the smaller irregularities of the curve, the ray seems to have moved more or less abruptly to a distance from its normal position, after which the mirror gradually settles to rest. Careful measurements give, for the arc through

which the pendulum frame is tilted, the numbers contained in column 5.

Unfortunately, between August 30 and September 4, the record is incomplete, some fifty hours having been lost by the photographic paper repeatedly running so much to one side as to stop the clock. This difficulty, it is hoped, has now been overcome.

THOMAS HEATH.

Royal Observatory, Edinburgh, October 26.

Whirlwind on "Rydal Water."

SOME friends and myself were staying at Lowwood Hotel, Windermere, for a few days, and on Friday, October 16, we were walking by "Rydal Water," on the opposite side from the road, when we noticed a very curious and most unusual effect on the water, caused by a sudden very heavy squall of wind, which seemed to come from two directions at one time, creating a "whirlwind," and raising the water and spray on the lake fully 100 feet high or more. There were eight or ten of these disturbances during the time we stayed (probably about twenty minutes), and I was fortunate enough to have my hand-camera with me and to photograph the largest of them, which came sweeping down the lake towards the island (near the centre), and finally broke on the shore with a boom like a cannon, which threw the débris, &c., at the side into the air quite 40 feet high. I have seen small whirlwinds strike on various lakes, but never anything of the magnitude of this. Thinking the incident might be of interest to you, I send you a photograph to make what use of you like.

Whirlwind on "Rydal Water," and smaller one in distance, October 16.

Had a small boat or ordinary Windermere yacht been caught in one of these whirlwinds, she must have been swamped.

HENRY J. C. ANDERSON.

Rodono, Great Crosby, near Liverpool, October.

The "G" Section of the British Association.

PERHAPS I may be allowed to make a few remarks concerning the above Section, and the strictures passed on October 22 upon its work, by the writer of the report in your columns. The writer is not singular in his criticisms, for others representing the scientific and practical sides of engineering also speak from time to time in a disparaging way, both of the subjects themselves, which are dealt with under the head of Mechanical Science at these annual gatherings, and of the methods of dealing with them.

I am not in any way concerned in defending the present state of things, but I would point out that no one yet seems to have suggested any really better general plan of carrying on th business of the Section. The writer in your columns indicates, for instance, that the week should be devoted to discussions such as that upon the fracture of railway rails, or the report on tidal influences. While admitting the value of these two communications, and others of a similar kind, there appear to be serious objections to limiting the work of the Section entirely to such matters, which work, I venture to think, your reporter entirely mistakes in its relation to technical societies. These societies, such as the Institutions of Mechanical Engineers, of Naval Architects, of Electrical Engineers, of Mining Engineers, and the Iron and Steel Institute, specialise their work, and deal often in a different way with quite different subjects. Now the British Association affords a common meeting ground for all interested in these and other branches of applied science, and, indeed, for many who may not have any special knowledge of any branch at all. Hence papers, or even lectures, upon which discussion is admitted and invited, dealing with dock works (which surely it is quibbling to exclude from the range of mechanical science), electric railways, the Tower Bridge, waterworks, not to say of armour and ordnance, of wreck-raising, of motor carriages, &c.—in all of which an account was given of progress in applied science—seem to form an important part of the work of the Section. Indeed, those authors who took the trouble to prepare illustrations, lantern slides, and models to make their subject clear and interesting, or even, if you like, "popular," deserve the hearty thanks of those present.

It might perhaps be a good thing to make some division in the day, so that the scientific papers and discussions which, to be frank, frequently empty the room, might be taken early before a certain hour, after which papers of a more popular character might be announced for reading and discussion.

As for trade articles, it might be fairly argued that new inventions not coming under that head—even scientific instruments, for example—have generally no value or interest at all; and the Committee of the Section seem always to try and ascertain, before accepting a communication of this sort, if there is sufficient novelty and scientific interest to warrant its acceptance; and in this matter, the "morality" of the Section need not be higher than that of technical societies. Indeed, if advertisement were a ban to acceptance, a good many of the authors themselves at most of the Sections would be hopelessly rejected. The "touting circular" referred to, if indeed it can be called such, was given out by one of the secretaries to only a portion of the meeting, and the remaining copies withheld when his attention was called to the contents. It is scarcely right to intimate that this sort of thing ever occurs except as a rare accident.

H. S. HELE-SHAW.

Walker Engineering Laboratories, University College, Liverpool, October 26.

P.S.—Mr. Johnson, of Derby, is mentioned in mistake for Mr. R. E. Johnston, Engineer of the Joint London and North-Western and Great Western Railways.

Suggested Reef Boring at the Bermuda Islands.

THE issue of NATURE containing the notice of the failure of the Royal Society boring expedition has just reached me, so I hasten to call attention to the great value of the Bermudas as a permanent home for a scientific station, and where borings might be readily conducted at any convenient time. A glance at the map will show that the fauna of the deep sea, of coral reefs, the avifauna of the ocean, and a complex meteorology, may all be studied at one and the same station, and in close proximity to New York and Halifax.

Could the Smithsonian Institution or the Royal Society be induced to take the matter up, it would seem to be an easy matter to organise a station, as the funds required are not large.

The town of St. George's very probably would give a dock with house attached, and possibly the colony a small sum annually. If the Universities of America would take an interest in the matter, the enterprise might be immediately pushed along

I should like to see in NATURE the views of some scientific men on this matter, both of Britain and America.

The question is certainly of great importance to scientific inquirers in nearly all branches of scientific endeavour, and it is to be hoped abler minds than mine may lay hold of the enterprise.

W. K. MORRISON.

Devonshire, Bermuda Islands, October 15.

Siemens' Domestic Gas Fire.

DR. POLE's letter on the Siemens' Domestic Fire drew my attention to the inquiry on the subject which Mr. Foster addressed to you in his letter published in NATURE of September 17.

I have had one of these fires in my office at the Society of Arts for some years. It was put in under Sir William Siemens' own superintendence, about the time when he described the grate in NATURE, so it must have been at the end of 1880 or the beginning of 1881. For a long time I used it with coke in the manner intended by the inventor; but practically I have found it more convenient to use ordinary coal, although it is doubtless less economical.

As Dr. Pole points out, the convenience of having gas ready to be turned on whenever the fire gets low or goes out, is very great; and in cases where a rather wasteful consumption of gas can be prevented, or is not considered of great importance, there can be no doubt but that the fitting of a few gas jets to an ordinary grate is a very great convenience. There is also a good deal of trouble saved in the lighting of the fire, as no paper or wood is required; the grate is simply filled with coal, and the gas turned on and lighted. The fire, I should say, burns up at least as rapidly as when lighted in the ordinary way.

If any of your readers are interested in the question, they are very welcome to see the grate at work whenever they like to call here.

H. T. WOOD.

Society of Arts, John Street, Adelphi, London, W.C., November 2.

Diselectrification by Phosphorus.

IN the course of some experiments made a few weeks ago, upon the discharge of electricity by air which had been traversed by X-rays, it occurred to me to try whether similar action would be exerted by air in which phosphorus was being oxidised. I found that a gold-leaf (Dutch metal) electroscope was quickly discharged when a stick of phosphorus was held near it. A small metal crucible was afterwards connected with the electroscope, and a clean slice of phosphorus half an inch in diameter was supported within it at a distance of about half an inch from its sides and bottom. The electroscope was completely discharged in six seconds, the action being more rapid than that of a burning strip of nitrate of lead touch-paper one inch in width.

It might be found convenient to attach a lump of phosphorus instead of a fuse to the nozzle of a water-dropping collector in times of severe frost.

I do not remember to have met with a previous record of this observation. It is of interest in connection with the note on slow oxidation, in NATURE of October 29 (p. 631).

SHELFORD BIDWELL.

The Departure of Swallows.

"E. P." mentions in NATURE of October 22, a date, somewhere about October 20, I presume, which he considers is an unusual one for swallows. Now, though the bulk of the swallows have left by this time, it is by no means unusual to see them later on in the year. In 1894 I saw swallows in Kent, in the neighbourhood of Tonbridge, on October 20, 21, 25 and 27, and the last one on November 11; it was flitting about a village in a bewildered sort of way, with a crowd of village boys throwing mud and clods of earth at it.

The same year a flock of martins stayed near some buildings from October 28 to November 16; by this time many of them had died of cold.

The latest swallows I have seen this year I saw on October 23, near the same buildings.

J. BROWN.

Tonbridge, Kent.

I BEG to send you the following extracts from my journal respecting the late appearance of the swallows.

1855, December.—It is worthy of record that several swallows were seen in this locality towards the end of November and during the first week of this month. I have ascertained that they were seen in other counties at the end of November; it must not be considered, therefore, as a merely local or solitary instance of the late appearance of these birds.

1863, October.—A few swallows were seen flying above the church on the 24th, and again on the 31st.

1867, November.—Some swallows were observed flying about during the last week.

These observations were made at Uckfield.

C. LEESON PRINCE.

The Observatory, Crowborough Hill, Sussex, October 26.

A Mechanical Problem.

THE mechanical problem proposed by your correspondent, "Cromerite," in the last issue of NATURE (October 29), is practically answered by the so-called "jumping beans" that are now being exhibited and sold in many parts of London. In this case a hard, rigid seed is seen to travel about in a series of small jerks, being slightly lifted from the ground at each movement. Upon dissection the seed is found to be hollow, the original contents having been devoured by a coleopterous larva —a soft fleshy maggot—which now partially occupies the cavity, and by its spasmodic movements causes the strange antics of the natural box in which it is enclosed. The walls of the seed appear to be quite rigid and inelastic.

E. E. GREEN.

November 1.

HERTZ'S MISCELLANEOUS PAPERS.[1]

ANYTHING written by Hertz is of interest; and these papers are of interest, not only on this account, but also on account of their suggestiveness. It is always a question as to the desirability of republishing and translating papers published some years ago. Most valuable papers of ten years' standing have produced their effect. Their vitality has been transmitted to and reproduced in subsequent work, but what the scientific world requires is advance rather than revision. The work of pioneers is, however, largely an exception to this rule. They are generally in advance of their times, and much of their work is of value long after it was done. Such an one was Hertz. Most of his papers are suggestive of questions which still require answers, and they all breathe a spirit that, as he says himself of Helmholtz's work, evokes "the same elevation and wonder as in beholding a pure work of art." His papers are not mere enumerations of observations, nor mathematical gymnastics. Each has a definite purpose and an artistic unity. A life-giving idea pervades it. It is no mere dry bones, but an organic whole that lives for a purpose, and does some work for science.

Prof. Lenard has earned much gratitude for his Introduction. It gives a charming picture of Hertz, of his simplicity, his devotion to science, his loving regard for his parents. There is just enough added to the very well-selected letters to give the reader a continuous view of Hertz's work, and enable him to follow its development, and hence feel an interest in it and sympathy with the worker, thus fulfilling the best ideal of the biographer.

One of Hertz's first investigations was as to the kinetic energy of an electric current. The question is still of great interest. It is known that the magnetic induction that accompanies an electric current behaves exactly as if it were a mass moving with inertia. This is the inertia of magnetic induction. Hertz was, however, looking for a different inertia. He looked at the subject from the flow of electricity point of view. He thought that there might be some phenomenon corresponding to an inertia of the electric charges, which upon this theory are supposed to be flowing in opposite directions through a conductor. He supposed that these might have some inertia

[1] "Miscellaneous Papers." By Heinrich Hertz. With an Introduction by Prof. Philipp Lenard. Translated by D. E. Jones and G. A. Schott. Pp. 364. (London and New York: Macmillan and Co., Ltd. 1896.

in addition to the magnetic inertia which accompanied their motion. To test this he tried two different forms of experiment, and obtained results which showed that if there were inertia of this kind, it must be small compared with that of the magnetic kind. The first method consisted essentially in a careful comparison of the extra current in a conductor with its calculated value; the second consisted in observing whether anything like the action by which the trade winds are deflected from a due northerly and southerly flow by the rotation of the earth, could be observed in a rotating conductor when traversed by an electric current. That there is some directed inertia in the conductor when traversed by an electric current is very probable, and in some cases we can be sure it exists. Hertz himself remarks that the inertia of the motion of the ions in electrolysis is considerably greater than what he was looking for in a metallic conductor. He could not make sufficiently delicate experiments with his apparatus to detect it, however, when using the small densities of current that were available in liquids; but the question is of great interest, and deserves further investigation. There can be no doubt that in gaseous discharges, kathode rays, as well as in electrolysis of liquids, there is a directed motion of matter accompanying the electric current which would be of the nature of the inertia Hertz was looking for, but failed to find. There seems much reason for thinking that in metallic conductors some similar actions are also taking place. Besides all this, there is the question as to how far the theory that all electricity is molecular and consists of electrons, involves the supposition of an inertia of this kind. Is the inertia of an electron completely specified by the magnetic force accompanying it? Does it occupy no space itself, and is its external field its all? We are hardly in a position to answer such questions. We might, however, be able to answer the former question as to the inertia of the directed matter movements accompanying the current, and as to another interesting question of a similar kind, namely, as to how far we can legitimately assume the current inside a conductor to be absolutely homogeneous. The self-induction of a single wire of a square m.m. in section is not exactly the same as that of, say, a hundred wires each of the thousandth of a square m.m. in section, and distributed over the square m.m. Subdividing the current would increase its self-induction. Outside the wire the distribution of magnetic force would be practically the same as before, but inside we would have it concentrated into a hundred small wires instead of being uniformly distributed, and the effect of this would be to slightly increase the self-induction, and the more so the smaller the section of each wire into which the square m.m. were subdivided. Hence we conclude that if the current in a real wire be from molecule to molecule, and so be concentrated on certain lines, its inertia should be somewhat greater than that calculated from the hypothesis that it is uniformly distributed over the section of the conductor. The difference between these two views is most clear when we consider the case of a Leyden discharging by its insulating medium becoming a conductor. If the Leyden be completely closed, and the medium become a conductor in such a way that the strain in each cubic cm. is there destroyed by conductivity, there will be no magnetic force anywhere accompanying this discharge of the Leyden, and consequently no magnetic inertia, if the conduction be perfectly homogeneous. Now it seems almost impossible that any directed change can take place without some accompanying inertia, and we may consequently conclude that either (*a*) an electric current has inertia such as Hertz was looking for, or (*b*) electric conduction currents are essentially heterogeneous, or (*c*) electric conduction is essentially accompanied by material inertia, or (*d*) two or all three of these are true. That (*c*) certainly exists in this case is incontestable in view of the known directed strains that Kerr and Duter have proved to exist in matter subject to electric stress. What is the complete answer, is the important question. It is still unsolved. It lies at the foundation of every theory of electric conduction. Hertz attacked it. It is still waiting solution.

The papers on the contact of elastic spheres and on hardness are most valuable contributions to the subject. They place the question of hardness on a scientific basis, and lay the foundation for a quantitative study of this most variable property of matter. There is no quality in which different materials differ more than in hardness. Electric conductivity is perhaps as various as hardness, compressibility, and viscosity, but hardly any other quality of matter is at all comparable with these in variety of range. Of these hardness is one of the most important and least known, and since Hertz's work on it can be scientifically studied. Innumerable subsidiary questions arise in connection with it. Why are some bodies so easily polished? Is the polishing of marble connected with the ease with which crystals of calcspar can be twinned by pushing over one corner? What is the essential difference between polishing and grinding? What is the effect of impurities on hardness? Is it comparable to their effect on electric conductivity? What is the cause of this effect?

In considering the cracking of a material like glass, Hertz seems to think that its cracking will depend only on the tension; that it will crack where the tension exceeds a certain limit. He does not seem to consider whether it might not crack by shearing with hardly any tension. It is doubtful whether a material in which there were sufficient general compression to prevent any tensions at all, would crack. Rocks seem capable of being bent about and distorted to almost any extent without cracking, and this might very well be expected if they were at a sufficient depth under other rocks to prevent their parts being under tension. It is an interesting question whether a piece of glass could be bent without breaking if it were strained at the bottom of a sufficiently deep ocean. On the other hand, there seems very little doubt that the parts of a body might slide past one another under the action of a shear, and would certainly crack unless there were a sufficiently great compressive stress to prevent the crack, and that consequently a body might crack, even though the tensions were not by themselves sufficiently great to cause separation, and might crack where the shear was greatest, and not where the tensions were greatest.

Then follow some papers on hygrometry and evaporation. A very interesting point is raised in this latter connection. Can a liquid evaporate at an unlimited rate if the vapour produced is removed as rapidly as it is evolved? From two points of view Hertz shows that there is a limit, and by his experiments went far to show that there was no other cause limiting the rate of evaporation. The first point of view was that a limit is imposed by the difficulty of supplying heat sufficiently rapidly to keep the surface temperature constant. He does not seem in his experiments to have attempted to supply this by radiation, but was content to allow the liquid to supply itself by conduction and convection from below. The second point of view was that the molecules could not leave the surface faster than they would be moving in the vapour that was formed. Hertz's investigation of this case only assumes an average velocity for the molecules; he does not consider the distribution of velocity among the molecules, nor whether they escape equally easily in all directions. The experimental investigation of the conditions of evaporation is extremely difficult; and until some more satisfactory method of studying these conditions be invented, the rough approximation seems to be sufficient to explain the observations. It might be interesting to see whether there was any difference between

the superficial friction of a gas and a liquid which did not evaporate, and of a vapour in contact with its own liquid. In one case there would be no exchange of molecules between the two bodies that were sliding past one another, while in the second case there would be an exchange. A study of the conduction of heat between a gas and a liquid might also help to elucidate the nature of the exchange which takes place between a liquid and its vapour.

In the paper on the vapour pressure of mercury, there are some very rough approximations which are hardly sufficiently accurate for general application. One is as to the extent to which a saturated vapour obeys the laws of a perfect gas. Hertz assumes that this is more nearly true the lower the temperature. This is not generally so. For each kind of material there is a particular temperature at which its saturated vapour most nearly obeys these laws, and below as well as above this temperature it departs from these laws. Again, there is a process, described at the bottom of p. 203 and top of 204, which cannot possibly be carried out. He says: "Let a quantity of liquid at temperature T be brought to any other temperature. At this temperature it is converted into vapour without external work." This is absolutely impossible, and the equation he deduces from all this is not true, though it is sometimes a rough approximation to the truth.

There is a very interesting paper on the floating of bodies by thin sheets of rigid material like ice. Hertz shows that if the sheet be large enough it would be possible to cause a thin sheet of iron, which by itself would sink, to float by placing weights at its centre. The weights might so depress the centre and make the sheet so boat-shaped as to float both themselves and it.

In 1883 Hertz published a deduction from first principles of Maxwell's equations for the electromagnetic field in the symmetrical form, afterwards used by himself in his investigations on oscillatory discharge waves. He applies the very same arguments by which Helmholtz, Lord Kelvin, and others had argued from the work done by one electric current on another, that there must be a corresponding reaction of the second on the first current, and hence deduced electromagnetic induction. Hertz applies this argument to the case of a ring magnet changing in strength and producing magnetic force on another ring magnet in its neighbourhood, and doing work there, and shows thereby that there should be a magnetic force due to a changing electric field exactly corresponding to the electric force due to a changing magnetic field. This, of course, is what Maxwell describes as the magnetic effect of the changing electric displacement, and its effects are expressed by the very same equations as Maxwell deduces. The argument is no more and no less conclusive than in the corresponding application of the principle of the conservation of energy to deduce ordinary electromagnetic induction. Hertz is careful to point this out, for he was early imbued by Helmholtz with the fact that the principle of the conservation of energy is by itself utterly inadequate as a complete explanation of physical phenomena. He specially mentions himself Helmholtz's interest in this problem of the simplest basis for dynamics, and Hertz's last great work was to place general dynamics on a sound basis. The simplest of all cases is the easiest in which to see how the principle of the conservation of energy fails to give a complete solution. A body moving without any action from other bodies describes a right line at a constant velocity. The principle of the conservation of energy requires the constant velocity. But, why the right line? Conservation of energy cannot solve even the simplest of all examples. It would be well if some modern chemists would mark, learn, and inwardly digest this.

The part of Hertz's work which is of greatest interest just now is that in connection with kathode rays. He began with some very interesting observations on the aura accompanying spark discharges. It appeared to be projected from the positive electrode, and occasionally formed a vortex ring of incandescent gas, which lasted for an appreciable time between the electrodes of a jar discharging in air. Goldstein has noticed similar effects. and some recent experiments on the discharge of large Leyden batteries, in which some of the phenomena of globular lightning seem to have been reproduced, make it appear possible that this latter is a spherical vortex of incandescent air.

Hertz's study of kathode rays in 1883, set finally at rest two questions. In the first place he showed that the discharge in a gas may be as continuous as any other form of current. In no case are we absolutely certain that the current is absolutely continuous. On the large scale it certainly is; but all we know of electrolysis seems to show that on a sufficiently small scale the current is carried in detachments, and is consequently essentially discontinuous. This, however, was not the question at issue, and so far as a continuity of the same kind as that in any liquid electrolyte is concerned, Hertz showed that the discharge through a gas might be equally continuous. The second question he decided was as to the direction of flow of the average current in an exhausted space. He showed that the average flow at any point was nearly the same as if the whole space were a conductor: that there was no connection between the kathode rays and the flow of the current. From experiments on kathode rays projected down a tube, and quite away from both electrodes, he deduced that they produce no magnetic action outside the tube, although they are deflected by the magnet. His conclusion, that the kathode rays are not streams of electrified particles, was largely founded on this, and on another experiment on the action of electrostatic force on the particles. This experiment on the magnetic action of kathode rays is quite inconclusive, and it is very remarkable that Hertz should have attributed much importance to it. Whatever current was carried down his tube by the kathode ray must have come back the tube by the surrounding gas, and these two opposite currents should have produced no magnetic force outside the tube; and this is exactly what Hertz observed. In a similar way, what he observed in the case of a flat box was the average direction of the current, and he showed that this average direction was approximately the same as in a conducting sheet. This proved that if there were any concentration of the current along the direction of the kathode rays, this concentration was neutralised by a corresponding return current, so that the average current was as described. At the same time there does not seem much doubt but that the kathode rays only carry a very small part of the current. The third part of the paper is concerned with the electrostatic effects due to kathode rays. The experiments do not seem to fully justify the conclusion drawn, that kathode rays cannot be charged molecules. Sufficient account does not seem to have been taken of the shielding action of the conducting gas surrounding the kathode ray, nor of the way in which the potential is distributed between two electrodes in a gas. Hertz describes an experiment with two plates inside the tube kept at a considerable difference of potential. He says: "The phosphorescent image of the Ruhmkorff coil discharge appeared somewhat distorted through deflection in the neighbourhood of the negative strip; but the part of the shadow in the middle between the two strips was not visibly displaced." Now this is exactly what one might expect, because the fall of potential between two such strips is very small indeed, except close to the negative strip, and there the electric force *did* deflect the rays. Hence the conclusion is just the reverse of the one Hertz gives. From the experiment it appears that kathode rays do behave like electrified particles. It is very

remarkable that in all these investigations Hertz does not once even mention, as a thing to be explained, the repulsive actions which Crookes observed, and which have been almost universally attributed to the impact of gas particles.

The other important paper, on the transmission of kathode rays through thin metallic films, is particularly interesting as the starting-point for Lenard's work, which has resulted in the discovery of the X-rays. A good deal of what Hertz observed would be accounted for by the production of X-rays where the kathode rays meet the diaphragms, and by the reproduction of kathode rays mixed with X-rays on the other side of the diaphragm, which would thus act as a sort of local electrode. That something exists in a vacuum on the far side of such a thin film, which does not ordinarily exist in X-rays in air, seems conclusively proved by there being something there which can be deflected by a magnet. There seems no doubt that kathode rays themselves are quite invisible, and that it is only where they are interfered with by gaseous molecules or by phosphorescent solids that they are sources of light. This is very much what one would expect. An electrified atom would not in general be a source of light unless its free movement were interfered with by impact.

The concluding article, on his master Helmholtz's seventieth birthday, is a noble and generous tribute to that great teacher's abilities and character. How truly he portrays the important characteristics of a University Professor! "It is true that Helmholtz never had the reputation of being a brilliant university teacher, as far as this depends upon communicating elementary facts to the beginners who usually fill the lecture-rooms. But it is quite another matter when we come to consider his influence on trained students, and his pre-eminent fitness for guiding them in original research." The most important duty of a University is to increase the knowledge of mankind, and to train up a new generation who may be able to continue the good work. It is thus mankind has advanced since the dawn of civilisation in Egypt. He who produced the most enthusiastic disciples has most advanced the well-being and the well-living of the race.

G. F. F. G.

THE BUREAU OF ETHNOLOGY AT WASHINGTON, U.S.A.[1]

THE Bureau of Ethnology at Washington has, during the last sixteen years, been carrying quietly on a work of the importance of which, we feel sure, that a number of students of anthropology have no knowledge whatever; we are equally sure that work itself, as well as those who labour in it, has not received due recognition. It is now nearly thirty years since the exploration of the Colorado River of the West was begun by the Act of Congress in America, and it is nearly twenty years since the various geographical and geological surveys which sprang up in connection therewith were dissolved, and since the foundation of the United States Geological Survey became an established fact. In the course of the work carried on by the Survey its various members made most exhaustive anthropologic researches among the North American Indians, and the myriads of facts which these self-sacrificing workers collected were fortunately rescued for the benefit of all students, and for all time, by the beneficent help of the Smithsonian Institution, which had secured provision for the publication of a series of monographs on almost every subject connected with the manners and customs, history, religion, and languages, &c., of the various Indian tribes with which they came in contact. Under the authority of the Act of Congress, the Secretary of the Smithsonian Institution entrusted the management of this great work to the former Director of the Rocky Mountain Region Survey, Mr. J. W. Powell, and thus the Bureau of Ethnology was practically established. It is a pleasant thing to be able to record that Congress supported the work both with patronage and with pecuniary assistance, and all will confess that the contributors to the success of the Bureau have worked with a will so as to employ in the best possible manner, and to the best possible end, the funds which have been placed at their disposal. We have before us thirteen handsome volumes of Reports, each containing several hundred pages of closely-printed matter, and profusely illustrated with well-executed coloured plates, and many hundreds of woodcuts. No reviewer of these volumes could attempt to give an adequate account of them unless he had some scores of pages at his disposal, and it goes without saying that all that any writer can do here is to call attention to the plan of Mr. J. W. Powell's volumes and to the general contents, hoping that the reader will devote some portion of his leisure to the perusal of a set of works which are at once of the greatest interest to those who study man and his ways, and of the first importance to the student of ethnography.

In setting out on his work, Mr. J. W. Powell says that throughout "prime attention has been given to language," for "with little exception all sound anthropologic investigation in the lower states of culture exhibited by tribes of men, as distinguished from nations, must have a firm foundation in language. Customs, laws, governments, institutions, mythologies, religions, and even arts cannot be properly understood without a fundamental knowledge of the languages which express the ideas and thoughts embodied therein." As a result of this opinion, the officials of the Bureau of Ethnology have devoted themselves to collecting materials for dictionaries of the North American languages, and for chrestomathies, and in time they hope to put grammars of the same before the world. With a view of enabling the philological student to determine what help he may or may not be able to obtain from these languages, the authors of the volumes before us give, every here and there, selected texts accompanied by interlinear transliterations, much in the same way as the early Egyptologists used to do in publishing hieroglyphic texts; and there is no doubt that this is a most useful plan. That it enables the careful reader, at times, to trip up his editor is true; but it is an honest method, and will be much appreciated by all painstaking students, for comparisons of words can thus easily be effected. Turning, though only for a moment, from language and from the characters which express language, that is to say writing, we see at a glance that the peoples of North America had many things in common with the most ancient civilised nations of antiquity. We do not for a moment believe that every custom and belief which may be found among them should be used to connect them with the ancient Chinese, or Indians, or Babylonians, or Egyptians; but it seems perfectly clear that every primitive nation, wherever it may live on the globe, or whatever may be the circumstances under which it lives, has certain fundamental ideas about the future life, and religion, and morality, which closely resemble those of other early nations. It seems tolerably clear, too, that many anthropologists have erred somewhat in tracing connections between peoples of totally different races, which they have deduced from observing that they had many beliefs in common. A careful examination of the characters employed by early nations to express their ideas makes this quite plain, for as pictures were used by them all for this purpose, we have only to trace the conventional sign back to its oldest form to find out what fundamental ideas existed in their minds. Primitive

[1] The Annual Reports of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, by J. W. Powell, Director. 13 Annual Reports. (Washington: Government Printing Office, 1881-1896.)

man, wherever he existed, used as writing materials such natural objects as were readily obtainable. Strips of bark, dressed skins, pieces of wood, bones, flat pieces of slate or stone, rocks, clay, &c.; when he was sufficiently advanced to beat out or to cast plates of metal, iron and bronze were also used by him for this purpose. At a later period he found out the way to make papyrus and paper, and this once done the task of the writer was comparatively simple. His pen varied with the substance which he wrote upon; wood, stone and metal demanded a hard, sharp instrument, and skin and paper demanded only an object which would transmit the writing fluid to their surface in regular quantities at the will of the writer. Ink was in its earliest form simply a mixture of water with some burnt vegetable substance or mineral earth. The style and character of the writing were modified by the materials used; and this is only a natural result when we consider how easy it is to draw circles, curved lines, and intricate devices upon a smooth substance like dressed skin or paper, and how hard it becomes to cut the same in stone. From the Chinese and cuneiform characters we may learn how, little by little, the original picture forms disappeared before the general use of stone and clay, and we know that the style of writing which was used for State documents was very different from that employed in the ordinary business of life. In the clay tablets of the last Assyrian Empire, about B.C. 700, the cuneiform characters bear no resemblance whatever to those which are found on the monuments of the period of Entenna, about B.C. 4500; in the Demotic writing of Egypt, so far back as the period of the Ptolemies, the pictorial character of the ancient hieroglyphics (from which it was derived, through the intermediate form of the hieratic or cursive form of writing employed by the priests) has quite disappeared. When we come to consider the characters used for writing purposes among the North American Indians, so ably discussed by Mr. Garrick Mallery (see "Sign Language among North American Indians," in the *First Annual Report of the Bureau of Ethnology*, p. 263 ff.), we find many pictures which show that they have much in common with picture signs in other languages. The sun is represented by a circle, as in Egyptian and Babylonian; sometimes it has rays shooting out all round it, just as we may see it in one of the vignettes of the ninety-second chapter of the "Book of the Dead." Sunrise is symbolised by a part of the disk showing above the ground; in Egyptian the disk is seen rising between two mountains. The star is represented by a small circle with four rays shooting from it, each towards a cardinal point; in Egyptian the star often has five points, but one of them probably represents the rope or chain by which the Egyptians thought it was hung out in the sky, and in Babylonian a star usually has eight points. The moon is represented by a crescent, as in Egyptian, Chinese, and Babylonian; heaven is a vaulted space, but in Egyptian it is drawn like the flat roof of a house, and has, moreover, supports by which it stands firm on the earth. To represent clouds a number of dark conical masses are drawn within the vault of heaven; the common Egyptian determinative for words meaning cloud is a tress of hair, and it is probable that this idea is common to both Egyptians and Indians. Similarly among both peoples rain was represented by lines of water falling from the sky. In fact it would seem that natural objects, both animate and inanimate, were written always in the same way, whether the writers were Chinese, or Egyptian, or Babylonian, or people of Western Asia, or the makers of the Cretan pictographs which Mr. A. J. Evans has discovered, or North American Indians. Abstract ideas were probably expressed quite differently by all nations; but even to touch on this far-reaching subject would be beyond the scope of this short notice. It must, however, be mentioned in passing that Mr. Garrick Mallery has collected a series of most important facts in connection with this subject in his "Pictographs of the North-American Indians" (see *Fourth Annual Report of the Bureau of Ethnology*), a work which should be consulted by all who study the history of the development of writing in the world, and that he has further supplemented our knowledge of the subject by his later work, "Picture-writing of the American Indians" (see *Tenth Annual Report of the Bureau of Ethnology*). It is a curious fact that the peoples of North America did not invent an alphabet, as many of the other nations of the world have done, for it is clear to every one that a system of picture-writing, however simple, is really a cumbrous affair, and the misreading of a picture sign might be at times accompanied by dire consequences. At a very early period Chinese, Babylonians, and Egyptians introduced an alphabetic principle into their writing, and the Persians succeeded in abolishing entirely the picture element from their system. The other volumes of Reports are, each in its way, as interesting as those to which we have called attention, and from them we may learn that light and information can come from the West as well as from the East. The carefully made collections of ethnological facts, which we find in the series of works issued under the able direction of Mr. Powell, should do much to help and encourage other workers in their inquiries, and the scholarly way in which they have been set forth by his fellow-workers reflects the greatest credit upon the Smithsonian Institution, and upon all who have been connected with their publication.

NOTES.

It is stated that Lord Rayleigh has intimated to the Council of the Royal Society that he does not intend to seek re-election as one of the Secretaries of the Society.

The President of the Royal Society (Sir Joseph Lister) will preside at Prof. Dunstan's lecture at the Imperial Institute next Monday evening.

Lord Kelvin has been suffering for some time past from severe neuralgia in the head; but he is now much better, and was able on Saturday to attend at the Royal Society for an hour.

The celebration of the seventieth birthday of Prof. Stanislao Cannizzaro at Rome has been postponed to November 21, on account of the anniversary on July 12 falling in the University vacation. A Committee has been formed and has collected subscriptions, which are to be devoted partly to the production of a gold medal commemorative of the anniversary, the balance being handed to Prof. Cannizzaro to be applied at his discretion in the interests of science. Congratulatory addresses will be presented from various learned societies, and there will also be a ceremonial presentation of the medal and subscribed fund.

The recent Conference at Burlington House on the proposed International Catalogue of Scientific Publications appears to have stimulated interest in the subject-index to the Royal Society's "Catalogue of Scientific Papers," upon which the Society's staff is already engaged. The College Section of the American Library Association at their meeting last month unanimously passed the following resolution:—"That the Section has learned with great satisfaction that the Council of the Royal Society proposes to add to the debt which the scientific world already owes to it for its valuable 'Catalogue of Scientific Papers,' by making a subject-index to the papers contained therein."

A MEETING of the executive committee which has been formed in connection with the submarine telegraph memorial, was held on Friday last. Two resolutions were adopted as follows:—"That it is desirable to establish a memorial to the late Sir John Pender, G.C.M.G., to commemorate the leading part he took in the establishment and development of submarine telegraphy, and in its extension throughout the world." "That measures be taken for promoting in the year 1901 a general international memorial recording the jubilee of international submarine telegraphy." A meeting of the general committee will be held in about a fortnight, when the decision arrived at will be submitted for confirmation.

CHRISTMAS lectures specially adapted for children will this year be given at the Royal Institution by Prof. Silvanus P. Thompson, F.R.S., his subject being "Visible and Invisible Light." Prof. Augustus D. Waller, F.R.S., has been appointed Fullerian Professor of Physiology for three years, the appointment to date from January 13, 1897; and Dr. Alexander Scott has been made the Superintendent of the Davy Faraday Research Laboratory of the Royal Institution, the Directors being Lord Rayleigh and Prof. Dewar.

MR. R. ETHERIDGE, late of the Geological Department of the British Museum, has been awarded by the Royal Geological Society of Cornwall its first Bolitho gold medal, in consideration of his services to Palæontological science.

THE objects exhibited in the ethnographical section of the Millennial Exhibition at Budapest are to be used as the nucleus of an ethnographical museum. The collection of machines in the special exhibition of the means of transport are to form a railway museum, and the bulk of the exhibits in the agricultural section will be used for the foundation of an agricultural museum.

A REUTER correspondent at St. John's reports further mineral discoveries in Newfoundland. An immense deposit of silver and lead ore has been discovered at Lawn, on Placentia Bay. The lode is said to be one mile long and 18 feet deep, and is described as very rich. An offer of £50,000 for the mining rights is reported to have already been made. Rich gold-bearing quartz reefs have been found at Ming's Bight, 200 miles north of St. John's.

SCIENCE has just lost an eminent investigator and teacher by the death of Dr. H. Newell Martin, F.R.S., late professor of biology in the Johns Hopkins University, Baltimore, U.S.A. In conjunction with Huxley, Prof. Martin wrote a manual of "Practical Instruction in Elementary Biology," which was published in 1875. He was also the author of a number of text-books of physiology; and the seventh edition of his admirable volume on the structures and activities of "The Human Body" reached us only a few days ago. Prof. Martin was in his forty-eighth year.

IT is reported in *Science*, upon the authority of the Honolulu correspondent of the United Associated Presses, that Mr. C. R. Bishop has authorised the Trustees of the Bishop Museum to expend 750,000 dols. in building an aquarium and marine biological station at Honolulu, for the scientific study of marine life in the Pacific. Prof. W. T. Brigham has just returned from visiting European aquariums, and is prepared to complete the plans. A body of professors and investigators will be maintained, and students will doubtless be attracted from Europe and America.

WE regret to announce the death of Dr. Moritz Schiff, professor of physiology in the University of Geneva, at the age of seventy-six; of Dr. Julius T. Wolff, the director of the private observatory—Photometrisches Observatorium—at Bonn, and the last of Argelander's pupils, at the age of seventy-six; of Prof. Dr. Eugen Sell, honorary professor of chemistry in Berlin University, at the age of fifty-four; and of Prof. Gustav Kieseritski, professor of mathematics at the Polytechnic Institute in Riga.

THE death is announced of M. Lucien Trécul, an eminent botanist, and member of the Paris Academy of Sciences. The Paris correspondent of the *Chemist and Druggist* gives the following particulars as to Trécul's life:—"He was seventy-eight years of age, having been born at Mondoubleau (Loir and Cher) in 1818. He studied pharmacy in Paris, and became a hospital pharmacist in 1841, his best-known contemporaries being MM. Chatin, a former director of the Paris School of Pharmacy, and Georges Ville, professor of agriculture at the Museum. About this time Trécul was attracted by the study of botany, and soon afterwards devoted himself entirely to it. Early in 1848, he was asked by the Minister of Agriculture and the Paris Natural History Museum to go to the United States to study the feculent roots used for alimentary purposes by the Indian tribes of North America. He left France early in the same year, and for a long time followed an Indian tribe in its wanderings over the prairies near the Rocky Mountains. He got together a superb collection of plants and animals. The ship carrying them to France was, however, lost in a storm during her voyage. M. Trécul, not discouraged, recommenced his work. He proceeded to Texas and Mexico, from whence he sent valuable collections to the Paris Museum." He was a Chevalier of the Legion of Honour, and became a member of the Paris Academy of Sciences in 1856. For the past forty years, or more, he lived a very secluded life, and was only heard of by occasional communications to the Paris Academy, and through his written works.

NANSEN'S narrative, the forthcoming publication of which, in a newspaper, was warmly referred to in a note last week, appeared in the *Daily Chronicle* of Monday, Tuesday, and Wednesday. Never before, in our knowledge, has such a stirring story been told of life amidst the ice and snow of the frozen north, and certainly never has the pages of a daily paper been embellished with such brilliant illustrations as those which accompany Nansen's articles. Naturally the account deals almost entirely with the adventurous aspect of the expedition; and as this was summarised (from telegrams communicated by Nansen to the *Daily Chronicle*) in our issues of August 20 and September 3, no useful purpose would be served by repeating the descriptions then given. The geographical results of the expedition, so far as they have yet been made known, were brought together by Dr. Mill in an article which appeared in these columns on August 27. In his three articles in the *Chronicle*, Dr. Nansen carefully avoids going into any scientific details, and he is probably reserving these for the paper he will read before the Royal Geographical Society early next year. One or two natural history observations are, however, mentioned in the course of the narrative. In the neighbourhood of four islands in latitude 81° 38′ N. and longitude 63° E., in August 1895, large numbers of the rare Ross's gull (*Rhodostethia rosea*) were seen. We read: "This, the most markedly polar of all bird forms, is easily recognisable from other species of gull by its beautiful rose-coloured breast, its wedge-shaped tail, and airy flight. It is without comparison the most beautiful of all the animal forms of the frozen regions. Hitherto it has only been seen by chance on the utmost confines of the unknown Polar Sea, and no one knew whence it came or whither it went; but here we had unexpectedly come upon its native haunt, and although it was too late in the year to find its nests, there could be no doubt about its breeding in this region." From November 1895 to March 1896, no bears were seen, but foxes, both of the white variety and of the valuable dark-furred kind, constantly

came to the hut where Nansen and Johansen passed the winter. With the spring, a few days after the sun had appeared above the horizon, a flock of little auks was seen sailing past along the mountains to the north, and soon the mountains swarmed with them. The whole of that part of Franz Josef-Land traversed by the two explorers consisted of basalt, and once formed a continuous basaltic land, which is now, however, cut up into small islands. On the south side of the country a deep stratum of Jurassic clay occurs beneath the basalt, and in it was found numerous ammonites and belemnites. The proprietors of the *Daily Chronicle* deserve every credit for their enterprise in arranging to pay Dr. Nansen so much as 1500*l.* for the telegraphic account of his expedition, and 4000*l.* for the articles just published.

WE are pleased to be able to report that Prof. W. J. Sollas returned to Dublin, in the best of health, on October 28, from his travels in the Pacific. It will be remembered that the Royal Society gave a grant to a Committee to investigate a coral reef by boring, sounding and other methods, and the island of Funafuti, in the Ellice Group, West Pacific, was selected as being a promising atoll. We have already (NATURE, vol. liv. p. 517) noted that the boring was unsatisfactory; but the other portion of the programme was successfully carried out, and large collections of the land and marine fauna were severally made by Prof. Sollas, Mr. C. Hedley, of the Australian Museum, Sydney, and Mr. Stanley Gardiner. The party also collected plants and all the objects of ethnographical interest on the island. Dr. Collingwood made measurements of the natives, and other observations on their physical anthropology. Prof. Sollas carefully studied the physiography and geology of the island, and kept daily records of the maximum and minimum temperatures. The soundings made by the *Penguin*, under Captain Field, were so complete that an accurate contour map can be made of the submarine slope; probably in no case has a coral island been so accurately surveyed. Numerous photographs were taken by Prof. Sollas and Dr. Collingwood. The expedition was eleven weeks on the island. Prof. Sollas then proceeded to Fiji, where he stayed about a month and made a special geological tour in the interior, accompanied by the Hon. Dr. Corney and the Hon. Mr. Udal. We understand that results of some importance will follow from this journey. After calling at Samoa, Prof. Sollas went to Honolulu and made some geological observations in the islands of Oahu and Hawaii. Mr. Hedley returned with his collections to Sydney, where he is working out his results. Mr. Gardiner is now in Rotumah. We hope that it will be possible to include *all* the results of this expedition in a single publication, instead of their being published in scattered papers. If this were done, we should have such an account of the physical structure, flora, fauna, and anthropology of a single coral island as has never yet been brought together in one volume. The scientific men associated on the expedition are now so widely scattered, that no time should be lost if their various observations are to be collected and coordinated.

THE committee appointed by the Entomological Society, for the protection of British Lepidoptera in danger of extermination, held a meeting on October 14: Prof. Meldola, President of the Society, being in the chair. Letters from the City of London Entomological and Natural History Society, the North London Natural History Society, and the Leicester Literary and Philosophical Society, expressing warm sympathy with the object of the committee, were read. After discussion of the best methods of securing the object of the committee, it was resolved to invite information as to species in special danger of extermination, with a view to future action.

HE is a bad workman who grumbles at his tools, and the student of science who neglects research because he does not possess apparatus ready-made and varnished by the instrument-maker, lacks the spirit of the investigator. Test the efficiency of the things at your disposal is good advice, for the knowledge and experience gained by direct communion with nature, even through the roughest apparatus, is a very valuable educational training. Because this is so, and because we hold our highest function to be the encouragement of research, we have pleasure in noting that "a Yorkshire lad," Mr. G. W. Watson, of Keighley, has obtained some wonderfully good Röntgen photographs by using an old home-made Wimshurst machine to illuminate a Crookes' tube. The machine gave a spark about 1¾ inches in length, and was without condensers. With this primitive equipment, good radiographs of the bones of the hand were obtained in twenty minutes. One of these pictures, and also a radiograph of an abnormally developed elbow, have been submitted to us; and both are very creditable productions. The definition is unusually clear, and the hollow structure of the bones is distinctly visible. Mr. Watson's success may induce others to see what they can do with simple means.

WHILE the bison of North America is on the point of extinction, the European bison, which is still found in Russia and the Caucasus, is sensibly decreasing in numbers, in spite of the efforts made for its protection by the Imperial Government. Herr Buchener (says the *Zoologist*), in a memoir on the subject recently presented to the Imperial Academy of Sciences at St. Petersburg, regards it as likely soon to share the fate of its American relative. In the forest of Bialowicksa, in the province of Lithuania, a herd of these fine animals has long been preserved, and forty years ago, namely in 1856, numbered about 1900, but of late years this has dwindled down to less than 500, and there is no encouraging sign of any material increase. Our contemporary points out that if the Russian Government would only give instructions to have some of the Caucasian bison captured alive and transported to Lithuania for the purpose of resuscitating the herd there, no doubt in a few years a marked improvement might be effected. The enterprise would necessarily be attended with considerable difficulty and great expense, but in view of the scientific importance which would attach to the result of the experiment, it would be well worth undertaking.

THE renowned "Bourbon" sugar-cane is so subject to diseases, particularly to attacks of Rind fungus, that the question of the most profitable variety of cane for cultivation in the Leeward Islands is of much interest and importance to the colony. Some facts are brought to bear upon this question in a report by Mr. F. Watts and Mr. F. R. Shepherd, published as a supplement to the *Leeward Islands Gazette*, detailing the results of experiments on the cultivation of different varieties of sugar-cane with the view of ascertaining which varieties are best able to resist disease. The results of their observations show that the best canes for planting in Antigua are those designated White Transparent, Naga B, Red Ribbon, Caledonian Queen, and Queensland Creole. These varieties held their own under different conditions of drought and infection; they were free from Rind fungus, and yielded juices of high purity and great saccharine richness. The Keni Keni cane, which, when it was first introduced into the colony, gave the best yield of any, has now fallen practically to the bottom of the list. It is an ally of the Bourbon, and is badly attacked by the Rind fungus. A curious fact is that both the Bourbon and Keni Keni canes should deteriorate in this manner, though the latter seems to have changed for the worse much more rapidly than the former. Further observation on this point would be of considerable interest in connection with the stability of varieties in relation to disease.

NOT so very long ago, the proposal to raise sugar-canes from the seeds would have been treated with ridicule, but, thanks to the work at Demerara and Barbados, and the experiments at the

Royal Botanic Gardens, Trinidad, it is now known that the sugar-cane will grow from seed, and that remarkable variations are produced. A short account of the share taken by the Trinidad Gardens in raising these seedlings is given in the Trinidad *Bulletin of Miscellaneous Information*, by Mr. J. H. Hart, the Superintendent. As a result of the experiments, sugar-canes have been produced that have given 25 per cent. above the yield of varieties commonly grown. If these varieties can be successfully got into plantations on a large scale, no further proof will be required of the value of the work done by Botanic Gardens. It is proposed to distribute cane plants of the new varieties early next year, and we trust that the results of their cultivation will be satisfactory in every sense of the word. Mr. Hart points out that the effort of the raisers of the sugar beet have long been directed to secure a strain of plants that would, while giving a large yield per acre, afford at the same time the maximum amount of sugar, and their efforts have been attended with great success, for it is well known that the yield from roots cultivated of recent years show a tremendous advance over the percentage yielded by the beet twenty years ago. Had the yield of the cane increased in the same proportion as that of beet, the sugar industry would not have suffered as it has done of late.

PROF. RALPH S. TARR contributes to *Science* a description of the recent expedition to Greenland, conducted by Lieut. Peary. The principal geological results are briefly stated as follows:—"At Turnavik, on the Labrador coast, evidence of recent glaciation is abundant. The hills are all rounded; there has been little post-glacial decay, and the transported boulders, as well as the bed rock, are very fresh. Upon exposed rock faces, unprotected from the weather, glacial striæ are still very distinct. Granting equality of weathering, this region has been much more recently glaciated than regions of similar geological structure in New England. The amount of glacial carving has not been sufficient to lower the surface of the gneiss to the level of the pre-glacial decay in the trap-dike valleys." On Big Island and the neighbouring coast of Baffin Land, evidence of very recent elevation was found up to a height of 270 feet above sea-level. The results of the study of the Nugsuak peninsula are interesting. The peninsula extends twenty-four miles from the front of the Cornell glacier to the end at Wilcox Head, while the Duck Islands are at a distance of eight or ten miles from the mainland. The Cornell glacier was found to have undergone recently a rapid withdrawal, and its retreat is believed by Prof. Tarr to be a part of a general withdrawal of a vast ice sheet, which extended outward beyond the Duck Islands. The entire Nugsuak peninsula has been so recently glaciated, that striated rocks are still present even at the outer end.

ACCORDING to the usually accepted theory of Crookes' tube, antikathodic rays are produced wherever kathodic rays impinge on a fixed obstacle. In the *Bulletin de l'Académie Royale de Belgique*, M. P. De Heen advances the theory that these rays result from encounters between molecules projected from the anode and kathode respectively. In verification of this view, experiments were made with a tube in which the usual anode was replaced by two parallel laminæ of aluminium at a small distance apart. When either of these laminæ was used as anode, the kathode being at the other end of the pear-shaped tube, antikathodic rays were observed; but these disappeared entirely when the two parallel laminæ were used as anode and kathode respectively. This result was easily explained by the fact that the space between the two surfaces was too small to allow of frequent collisions taking place between the anodic and kathodic projections. On the ordinary theory, however, the kathodic projections would traverse the space between the laminæ with great facility, thereby giving rise to a copious emission of antikathodic rays, contrary to observation.

THE *Proceedings* of the fifty-fourth meeting of the American Association for the Advancement of Science, held at Springfield, Mass., in August and September 1895, have lately been published.

IN the *Meteorologische Zeitschrift* for October, General Rykatcheff publishes a note on the meteorological observations at the St. Petersburg and Pavlovsk observatories during the solar eclipse of August 9.

THE *Bulletin of the Torrey Botanical Club* for September reprints Dr. N. L. Britton's brief account of the Botanical Gardens of the world, given as the vice-presidential address before Section G of the last meeting of the American Association for the Advancement of Science. The total number is given as over 200, but some of them are little more than pleasure parks. Of the total number, Germany possesses 36, Italy 23, France 22, Russia 16, Austro-Hungary 13, Great Britain and Ireland 12, and the United States 10.

THE *Bibliothèque universelle*, a monthly review now published in Lausanne, Switzerland, has recently celebrated the hundredth anniversary of its foundation. It was originally established in Geneva, under the title *Bibliothèque britannique*, by Frédéric Guillaume Maurice and the brothers Marc Auguste Pictet (pupil and friend of the famous naturalist Saussure) and Charles Pictet de Rochemont, its chief object being the diffusion of English ideas and scientific researches in France and Switzerland. It numbered among its earliest contributors Sir Humphry Davy, Edward Jenner, Sir Joseph Banks, the physicist Charles Earl of Stanhope, and, at a somewhat later period, Sir John Herschel.

ARRANGEMENTS are being made to commemorate the sixtieth year of the reign of Her Majesty Queen Victoria by an exhibition at the Crystal Palace, to be opened on May 24, 1897. It is proposed to illustrate by models and practical examples the famous inventions in arts and industries during the past sixty years, and also the progress of other sides of national development. As a sort of prologue to this exhibition, a series of popular lectures, dealing with the advancements in science made during Her Majesty's reign, will be delivered during March and April next.

THE next session of the Anthropological Institute commences on Tuesday, November 10. A number of interesting communications are promised, among others being papers by Prof. E. B. Tylor, on North American Wampum Belts; by Dr. Oscar Montelius, on the Tyrrhenians and the pre-classical period in Italy; by Dr. J. H. Gladstone, on the transition from the use of copper to the use of bronze; by Lieut. Boyle T. Somerville, R.N., on the natives of South Georgia (Solomon Islands); by Miss G. M. Godden, on the Nagas and other hill tribes of the North-East Indian frontier; by Dr. Colley March, Miss Christian Maclagan, and Mr. R. H. Mathews. At the first meeting Mr. H. Balfour, of the Pitt-Rivers Museum, Oxford, will exhibit a remarkable bow found in Egypt, and believed to be Assyrian, and will read the life-history of an Aghori Fakir, exhibiting drinking-bowls made from human skulls. Mr. C. H. Read will exhibit a curious wooden carving executed by a Haida Indian, apparently from a model of a sphinx; and a wooden dance-mask from the north-west coast of America. Mr. P. L. Sclater will exhibit a "draught-board" from Nyassaland; and Mr. Balfour will show a number of transparent sections of composite-bows of various times and countries.

TWELVE years have elapsed since the publication of Phillips's well-known and widely-consulted "Treatise on Ore Deposits." In this period the subject of metalliferous deposits has undergone such extensive changes, both material and theoretical, that Prof. Henry Louis, in preparing the second edition, which Messrs.

Macmillan and Co. will issue in a few days, has had to introduce many modifications of the original text, and make many additions. Especially is this the case in the first part of the work dealing with the classification and genesis of ore deposits. This has been entirely rewritten in order to bring it into accordance with modern ideas. The second part of the work, being mainly a record of facts and observations on ore deposits of the principal mining regions, has not needed to be recast, though the results of recent studies, and of newly-developed fields and deposits have been added. The work has thus been rejuvenated, and will continue to hold its high place among mining literature. Another new edition to be published by Messrs. Macmillan in a few days, is Ziegler's "Special Pathological Anatomy." The first English edition of this standard work was published in 1884, but the edition (the third) shortly to be issued differs from it very considerably, having been translated from the eighth German edition. So great have been the advances in pathological anatomy during the past twelve years, that the text has had to be completely rewritten. The forthcoming volume has been translated and edited by Dr. Donald MacAlister and Dr. Henry W. Cattell. The second volume of the work is in the press, and it will be followed by a new version of the part on general pathological anatomy.

THE researches of Émil Fischer on the action of phenylhydrazine on the various sugars have shown that either a simple hydrazone is formed, by the reaction of the aldehyde or ketone group of the sugar with the amido-group of the hydrazine, or that, in addition to this, the hydrogen atoms, combined with the carbon atom adjacent to the carbonyl group, are removed, and a second molecule of phenylhydrazine enters into reaction, an osazone being formed. In a paper published in the current number of the *Berichte*, E. Davidis describes two new types of hydrazine derivatives of the sugars, which have been obtained in the laboratory of Prof. Curtius. When a sugar such as glucose is warmed with hydrazine hydrate and a little methyl alcohol, two molecules of the sugar react with one of the hydrazine, and glucosaldazine, $C_6H_{12}O_5 : N.N : C_6H_{12}O_5$, is produced. Similar compounds are formed by fructose and arabinose, and they are all readily hydrolysed by dilute acids. Compounds of the second type are formed when the sugar is treated with an acid hydrazide, such as benzhydrazide, $C_6H_5.CO.NH.NH_2$, in the presence of dilute alkalis. Under these circumstances, no less than *four* molecules of the hydrazide react with one molecule of the sugar. The compound produced from glucose, which the author terms glucosebenzosazone, therefore resembles glucosazone in constitution, but differs from it inasmuch as the removal of the hydrogen atoms and reaction with the hydrazide has been extended to three consecutive carbon atoms. A portion of the benzhydrazide is simultaneously decomposed with formation of ammonia and benzoic acid. Lævulose yields precisely the same compound as glucose. It has, so far, been found impossible to prepare a benzosazone containing either more or less than four hydrazine groups. These compounds crystallise well, and melt at a comparatively high temperature; and it is therefore possible that they may play an important part in the investigation of the very complicated group of compounds to which the sugars belong.

THE additions to the Zoological Society's Gardens during the past week include a Mozambique Monkey (*Cercopithecus pygerythrus*, ♂) from South-east Africa, presented by Dr. John Archibald; a Hocheur Monkey (*Cercopithecus nictitans*, ♂) from Congoland, presented by the Rev. Lawson Forfeitt; a Syrian Bear (*Ursus syriacus*, ♀) from Western Asia, presented by Mr. G. A. Schenley; a Garden Dormouse (*Myoxus quercinus*), European, presented by Mr. W. H. St. Quintin; two White Storks (*Ciconia alba*), European, presented by Miss Agnes Woodroffe; a Black-backed Piping Crow (*Gymnorhina tibicen*) from Australia, presented by Mr. Charles G. Murrell; four European Tree Frogs (*Hyla arborea*) from Italy, presented by Mrs. Kneeshaw; a Beccari's Cassowary (*Casuarius beccarii*) from New Guinea, a Night Heron (*Nycticorax griseus*), two Purple Herons (*Ardea purpurea*), European, two Black-spotted Teguexins (*Tubinambis nigro-punctatus*) from South America, deposited; two Common Sheldrakes (*Tadorna vulpanser*), European, three Mandarin Ducks (*Œx galericulata*) from China, a White-faced Tree Duck (*Dendrocygna viduata*) from Brazil, received in exchange.

OUR ASTRONOMICAL COLUMN.

STRASSBURG OBSERVATORY.—The first contribution to astronomical science of the Kaiserlichen Universitäts-Sternwarte in Strassburg is contained in a handsome volume just published by the Director of the Observatory, Prof. E. Becker. This observatory, it may be remembered, was instituted in the year 1872, Dr. August Winnecke being called upon to fill the post of Professor of Astronomy, and make plans for the arrangements of the buildings and instruments. It is quite worth while recording the fact that almost one of the first acts of Germany after the conclusion of the war, was to arrange for the building of this observatory, showing that, to have an astronomical observatory, which should be a seat "der exacten Wissenschaften," was almost as important as a fortress. No less extraordinary is it that this volume of the "Annalen," just published, should contain the first full description of the buildings and instruments almost fifteen years after they have been set up. We are led to infer from this that the object of the Germans is, in any case, to collect facts, even if they cannot momentarily be published. The buildings were commenced in 1877, and by the summer of the year 1881 work had already begun. In this, the first volume of the "Annalen," Prof. Becker gives a full description of the different buildings and of the various instruments housed in them, illustrating them with eighty excellent photogravure plates. Among these latter are a large refractor of 487 mm. aperture and 7 m. focal length, by Merz, on a mounting by the brothers Repsold; a large comet-seeker with an objective, by Merz, of 162 mm. aperture and a focal length of 1·3 metres; a smaller comet-seeker, a transit instrument by Cauchoix, an orbit-finder (Bahnsucher), an alt-azimuth, and a Repsold meridian circle, having an object-glass of 160 mm. diameter and a focal length of 1·888 metres, by Merz. A thorough and complete investigation of this last-mentioned instrument was undertaken, the results of which are given in full detail. The observations which are here published extend from 1882 March 15 to 1886 September 9, and consist of meridian observations of the sun and chief planets, and of those stars, the positions of which were required for such different objects as comparison stars of comets, angular values of the heliometer scales, longitude determinations. In June 1884 the programme of work was considerably increased, the determination of the positions of 306 Anschlusssterne for the southern zones, and also of eighty-three stars of the southern fundamental catalogue of the Astronomischen Gesellschaft being the chief additions. Following the list of observations are the corrected readings of the meteorological instruments, the temperatures in the basement under the transit circle, and a short account of the climate of Strassburg as gathered from the meteorological observations made from 1873–79.

MARS IN AUGUST LAST.—Prof. V. Cerruli contributes some of his notes on the appearance of the Martian disc, during last August, to *Astr. Nach.*, No. 3384. Of the southern cap, he says, we have no sign. This fact cannot be accounted for solely by reason of perspective; it seems, however, that the southern snows, which diminished very rapidly in June and July, have undergone complete liquefaction. (The southern solstice occurred on July 13.) Ramification of the northern snow took place, according to his opinion, on August 25; on that day he observed for the first time "a flash of lightning more or less intense at the extreme north of Elisium," and this apparition was successfully repeated on the following days. It may be mentioned here that the bright flashes noted by the Lick observers, and others, were seen towards the southern pole in the region known as Chersonesus. With regard to the canals, he says that he was

able to identify a great many. Nilosyrtis appeared, however, very dim and small when compared to the Syrtis Major, which, at this time, is "probably in its maximum state of expansion." Ceberus, on the other hand, was observed to be very straight, wide and dark, and, it was thought, exhibited signs of gemination.

"HIMMEL UND ERDE."—The first number of the ninth year of this monthly contains many articles and notes of astronomical interest. Dr. G. Witt, of Berlin, contributes an account of the present state of our knowledge with regard to the planet Saturn, this being the first of two articles on this subject. The question of the origin of the surface markings on our satellite, the moon, is next raised, and the explanation given by Lœwy and Puiseux is brought into discussion. There are, also, two short notes on the rotation period of Venus and a remnant of the Biela comet. The former deals with Perrotin's work, while the latter informs us that Mr. W. E. Hidden, of Newark, U.S.A., is in possession of a piece of the meteorite, weighing 4·090 kilograms, which fell on November 27, 1885, in the neighbourhood of the town of Mazapil. This has been handed over to him by the director (Prof. Bonilla) of the observatory in Zacatecas (Mexico) for a mineralogical investigation. A brief account is given, also, of the new meteorological observatory adjoining the hotel on the top of the Brocken, and a short summary of the new contributions on the measurements of the heights of clouds, by Prof. Kaiser, in Danzig, and Prof. Koppe, in Brunswick.

THE REPORT OF THE ROYAL COMMISSION ON VACCINATION.

THE Report of the Royal Commission on Vaccination is one of the most moderate, and certainly one of the most convincing that has come from any Royal Commission during recent years. The Commissioners have, for seven years, been occupied in making most careful inquiries at all sources as to the efficacy of vaccination in rendering children (and adults) less susceptible to infection by small-pox virus. No trouble has been too great, and no expense has been spared to obtain accurate information as to the truth of statements made by the witnesses who appeared before the Commission; as to the trustworthiness of figures placed in evidence; as to the nature of the disease alleged to be due to vaccination; and as to the exact share that legal compulsion has had in promoting or preventing the vaccination of children. The conclusions at which the Commissioners have arrived are evidently based on the most thorough conviction that the evidence before them, after the careful sifting through which it has gone, is to be thoroughly trusted, whilst their recommendations as regards the alteration in the methods of operation, registration, and legal compulsion certainly appear to be those best calculated to increase the efficiency of vaccination, concerning the value of which they are so thoroughly convinced.

The main considerations of the Commission are arranged under a series of headings, which may first be taken seriatim.

(A) "As to the effect of vaccination in reducing the prevalence of, and mortality from, small-pox." Here they conclude "(1) that it diminishes the liability to be attacked by the disease; (2) that it modifies the character of the disease, and renders it (*a*) less fatal, and (*b*) of a milder or less severe type; (3) that the protection it affords against attacks of the disease is greatest during the years immediately succeeding the operation of vaccination. It is impossible to fix with precision the length of this period of highest protection. Though not in all cases the same, if a period is to be fixed, it might, we think, fairly be said to cover in general a period of nine or ten years; (4) that after the lapse of the period of highest protective potency, the efficacy of vaccination to protect against attack rapidly diminishes, but that it is still considerable in the next quinquennium, and probably never altogether ceases; (5) that its power to modify the character of the disease is also greatest in the period in which its power to protect from attack is greatest, but that its power thus to modify the disease does not diminish as rapidly as its protective influence against attacks, and its efficacy during the later periods of life to modify the disease is still very considerable; (6) that re-vaccination restores the protection which lapse of time has diminished, but the evidence shows that this protection again diminishes, and that, to ensure the highest degree of protection which vaccination can give, the operation should be at intervals repeated; (7) that the beneficial effects of vaccination are most experienced by those in whose case it has been most thorough. We think it may fairly be concluded that where the vaccine matter is inserted in three or four places it is more effectual than when introduced into one or two places only, and that if the vaccination marks are of an area of half a square inch, they indicate a better state of protection than if their area be at all considerably below this."

It is evident from the statistics given that the protection afforded by vaccination against small-pox, though lasting for some time, is gradually lost, so that there comes a period when the protection is very slight indeed. Re-vaccination is naturally the first remedy that suggests itself to meet this difficulty, and from the evidence collected by the Commission from the various epidemics that have occurred, and from the vaccination statistics of the various public services, it is made very apparent that the value of re-vaccination as a preventive of small-pox can scarcely be over-estimated. The proof of this is so conclusive, especially where it is based on the observations made on the ordinary staffs of hospitals, nurses, and the like, who are brought into close contact with small-pox patients, that the re-vaccination statistics alone are sufficient to prove the value of vaccination. The position taken up by Sir Guyer Hunter and Mr. Jonathan Hutchinson in this question in their minority report, appears to us to be the only logical one that could be arrived at, although the limits that should be placed upon compulsion, spoken of elsewhere, would also limit us in regard to re-vaccination. Only these two Commissioners recommend that re-vaccination at the age of twelve should be compulsory, and on the same lines as the initial vaccination; but now that School Boards have their age registration of the children in attendance on their schools, it would surely not be a difficult matter to ensure the vaccination of children of that age, in order that they might be protected through a period during which the susceptibility to the disease, though less than in the earlier years of life, is still considerable; the period, too, during which interference with training for work and with production of work is a very serious matter for the individual, and a matter equally serious for the State.

(B) "As to the objections made to vaccination on the grounds of injurious effects alleged to result therefrom; and the nature and extent of any injurious effects which do, in fact, so result." In regard to this they say "a careful examination of the facts which have been brought under our notice have enabled us to arrive at the conclusion that, although some of the dangers said to attend vaccination are undoubtedly real and not inconsiderable in gross amount, yet when considered in relation to the extent of vaccination work done, they are insignificant. There is reason further to believe that they are diminishing under the better precautions of the present day, and with the addition of the further precautions, which experience suggests, will do so still more in the future." The remedy for this, apparently, is the employment of calf lymph, which would wholly exclude the risks as regards both syphilis and leprosy. The second danger does not concern the British public, whilst the risk of syphilis, although real, is an exceedingly small one, even when humanised lymph is employed, and could probably be wholly avoided by care in the selection of the vaccinifer. As regards erysipelas, eczematous eruptions, and vaccinia maligna, calf lymph vaccination appears to have few advantages over arm to arm vaccination. This question is dealt with more fully in the following section.

(C) "As to whether any, and, if so, what means should be adopted for preventing or lessening the ill effects, if any, resulting from vaccination; and whether, and, if so, by what means, vaccination with animal vaccine should be further facilitated as a part of public vaccination." Here again the use of calf lymph is recommended, especially for those who have any doubt as to the source of "arm to arm" lymph. Extension of the age period from three to six months, and the adoption of the legal methods now in vogue in Scotland, are strongly recommended. Special attention is called to the necessity for care and cleanliness, not only during the operation, but also in respect to the instruments used; to the desirability that the operation of vaccination should be done at the child's home, except under special circumstances, to the necessity for postponement of vaccination when erysipelas, scarlet fever, measles, or chicken-pox are prevalent in the neighbourhood of the child's residence, or at the place of vaccination, or on account of the general health of the child, bad surroundings, or other conditions rendering the

operation at the time undesirable. The following recommendations are also made. The vaccination vesicles should not be opened unless for some adequate reason. The preservation of lymph in tubes instead of dry points (the storage of calf lymph in glycerine?), the careful sterilisation of all instruments used (which should be as simple as possible), and the exercise of care that the insertions of vaccine matter be not placed too close together, so that the vitality of the tissues between them may not be injured. It is thus suggested that greater latitude should be given to the medical man in deciding as to when vaccination should take place. On the other hand, along with compulsion of the parent, compulsion on the medical attendant to attend (should any unfavourable symptoms occur prior to the time fixed for inspection) should be made, and that notice should be given to parents that they are empowered to summon the public vaccinator. It is also pointed out that in any case where a child requires medical attendance owing to illness supervening on vaccination, that it should be the duty of the vaccinator to render such attendance if required by the parent, and that he should receive a fee in respect thereof. The Commissioners go on to state that "in our opinion, if the precautions we have suggested were adopted, untoward incidents of vaccination, already rare, would become much rarer."

Concerning the conditions of vaccination that obtain in Scotland (p. 135 of the Report), it is probable that any legal action that may be taken as a result of the report of the Commission will be based, to a large extent, at any rate, on the provisions of the Scottish Vaccination Act. As pointed out in the *British Medical Journal*, the essential features in which this system differs from that in vogue in England are the following. Almost the entire work of vaccination is carried on by the family doctor, who is paid for the operation and for the succeeding visit, just as he would be paid for an ordinary visit to the child; so that the parents, and not the rates, are charged with the expense. This, however, is a matter of detail, and the Commission recommends that any medical attendance required in consequence of vaccination, is not to be charged against the parents, but against the State. In a few large cities, especially in those where medical schools are located, public vaccination is resorted to. In these cities the public vaccine stations are in most cases in connection with the medical schools, though in some instances they are subsidised by municipal funds. State registration of vaccination is associated with birth registration. When the birth of a child is registered, the registrar hands to the person registering a notice requiring that the child shall be vaccinated within six months of its birth; the notice is accompanied by the usual certificate forms for successful vaccination, postponement, and insusceptibility. Every half-year the registrar sends a note of all who have not complied with the vaccination regulations to the inspector of poor under the Parish Council (Board of Guardians). This list of defaulters is placed in the hands of the public vaccinator, who visits those children who have not been vaccinated at their own home, or sees them at the office or dispensary of the Parish Council. Should the parents refuse to accept vaccination at the hands of the public vaccinator, but not till then, legal pressure may be brought to bear upon the parents, as in England. Of course it is contended that vaccination under these conditions cannot be inspected by a public inspector, and that very great latitude is allowed to the medical man as to what may constitute efficient vaccination; but, on the other hand, the vaccination being done by a trusted medical adviser does not arouse the same opposition that it does in England, with the result that in Scotland vaccination is accepted almost as part of the condition of registration of the birth of the child. A most important consideration in the Scotch system is that, as the period is six months instead of three, many of the dangerous illnesses of very early life, during which such a large proportion of children die, are not put down to vaccination, as they so frequently are in England. It has been suggested, indeed, that this period of six months might, with advantage, be extended to twelve, except when small-pox is epidemic, when vaccination should be done as early as possible. It is a striking fact that during eleven years (between 1884 and 1894) the number of unvaccinated children, *i.e.* those unaccounted for to the registrar, never rose to more than $2\frac{3}{4}$ per cent., and in 1894 this was as low as about $2\frac{1}{3}$ per cent. In the second half-year of 1892 only twenty-two prosecutions were instituted. There can certainly be little doubt that, although there may be slight disadvantages connected with the performance of vaccination by medical men at the homes of the children, these are of such a nature that they could very soon be got over, whilst the enormous advantages far more than outweigh any possible disadvantages. It has been pointed out there would be no need to take the child away from its home; consequently it would not be necessary to expose it to inclement weather, or to rough treatment of any kind, with the result that chills and broken vesicles would be of less frequent occurrence than under the present system. The possible danger of contracting erysipelas, scarlet fever, measles, and like diseases from other children at this time, would also be done away with, could attendance at public vaccination stations be dispensed with.

(D) "As to what means, other than vaccination, can be used for diminishing the prevalence of small-pox; and how far such means could be relied on in place of vaccination." In connection with isolation the Commissioners confess that they can see nothing to warrant the conclusion that in this country vaccination might safely be abandoned, and be replaced by a system of isolation; but whilst fully admitting the protective effect of vaccination, the Commissioners maintain that it does not diminish the importance of measures of isolation, or dispense with their necessity. They hold, moreover, that steps should be taken to procure a more general division of the isolation of small-pox patients than exists at the present time; and they recommend "(1) that common shelters which are not now subject to the law relating to common lodging-houses should be made subject to such law; (2) that there should be power to the local authority to require medical examination of all persons entering common lodging-houses and casual wards to see if they are suffering from small-pox, and to offer a reward for prompt information of the presence of the disease; (3) that the local authorities should have power to order the keeper of a common lodging-house in which there has been small-pox to refuse admission for such time as may be required by the authority; (4) that the local authority should be empowered to require the temporary closing of any common lodging-house in which small-pox has occurred; (5) that the local authority should have power to offer free lodgings to any inmate of a common lodging-house or casual ward who may reasonably be suspected of being liable to convey small-pox; (6) that the sanitary authority should give notice to all adjoining sanitary authorities of the occurrence of small-pox in common lodging-houses or casual wards; (7) that where the disease occurs the public vaccinator or the medical officer of health should attend and vaccinate the inmates of such lodging-houses or wards, except such as should be unwilling to submit themselves to the operation."

One remarkable fact in connection with this part of the question is that even the minority reporters against vaccination (only two in number, although at least four members of the Commission were supposed, originally, to be adverse to its use) can offer no new light on the question; any argument brought forward, in a half-hearted fashion, against the efficacy of vaccination, is based not so much upon actual statistics as upon a purely hypothetical basis.

The alternatives, improved sanitation and isolation, that are advanced in the minority report as being sufficient to take the place of vaccination, were of no avail during the Gloucester epidemic, during which vaccinators and non-vaccinators alike competed with one another in their zeal to have vaccinations and re-vaccinations performed at as early a date as possible; only as the population became well vaccinated did other measures appear to have any material effect in limiting the spread of small-pox. Of the extent of the vaccination that went on in this city, an idea may be gathered from the fact that during one period of seven days four public vaccinators operated on 548 patients for the first time, and re-vaccinated 1683. No medical man would for a moment desire to minimise the importance of improved sanitary surroundings and immediate isolation of small-pox patients in dealing with any outbreak of small-pox, and with the prevention of small-pox epidemics, but from the nature of the disease and the period during which the infective nature of the disease makes itself felt, it is almost impossible to prevent the transmission of small-pox by patients who are suffering from this disease during the earlier periods of its course. Small-pox is undoubtedly seldom transmitted from town to town except through tramps or through people who cannot be readily reached for inspection, simply because they do not apply for medical advice until the disease is well developed; whilst in regard to the cases that are not recognised during the earlier stages of the disease, it is probable that these will, from time to time, become more and more numerous from the fact that as there are periods during which

very few cases of small-pox are met with, it is impossible (during these periods) for medical men to make themselves familiar with the exact appearances by which they can accurately diagnose small-pox. It is only during periods of epidemic that medical students and practitioners are able to become familiar with the disease. Efficient sanitary administration is undoubtedly valuable because of the greater resistance that patients who are in good health undoubtedly exhibit against the attacks of all diseases, but it can never be hoped that the directly infectious diseases, such as small-pox, measles, and whooping cough, can be diminished by the most stringent sanitary measures, in the same proportion as typhus and the plague have been, and as cholera and typhoid are being reduced. As regards isolation and quarantine, it is evident, of course, that if every case of small-pox could be isolated at the time that infection took place, and if every case could be detained in quarantine-isolation at the part at which it occurred, small-pox might now be stamped out; but even this position could only have been reached by the aid of vaccination, as without doctors and nurses protected by vaccination or previous attacks of small-pox, it would be impossible to find attendants for these isolated patients. But the whole question of stamping out by these measures without vaccination, is so utterly absurd when the conditions under which the disease is generally spread are taken into consideration, that it is really startling that they should have been suggested as capable of taking the place of vaccination, however valuable they may be as accessory factors. One writer, commenting on the example which Leicester is stated to afford of the value of strict isolation, points out, "that vaccination was carried to nearly every one who was thought to have any chance of coming into contact with the disease, and that nearly every member of the hospital staff gladly accepted re-vaccination." The Commissioners reporting on this point state "that at Leicester, the region of isolation and sanitation, two vaccinated children under ten were attacked, neither of whom died; of unvaccinated children of a similar age, 107 were attacked, of whom fifteen, or 14 per cent., died. Of vaccinated persons over ten years of age, 197 were attacked, of whom two died, or 1 per cent.; of the unvaccinated at a similar age, 51 were attacked, of whom 4, or 7·8 per cent., died." In the case of the hospital staff at Leicester, we have a most striking proof of the efficacy of vaccination. On page 82 of the Report, par. 319, we have the following: "At Leicester, at the end of the year 1892, the staff at the hospital consisted of twenty-eight persons. Fourteen of these had either previously had small-pox, or had been re-vaccinated before the outbreak. Eight others were vaccinated at the time of the outbreak. The remaining six, although they had not previously been re-vaccinated, refused to submit to the operation. During the outbreak there was an addition of twelve to the staff dealing with small-pox cases. These were all re-vaccinated, and none of them contracted small-pox. Out of the twenty-eight, six were attacked by the disease, of whom one died. Five of the persons thus attacked, including the one fatal case (the person in whose case the disease was fatal was said to be of intemperate habits), were amongst the six persons who had refused to be re-vaccinated, though in the case of one of the five consent was afterwards given to the operation, but it was only performed on the day that she showed premonitory symptoms of small-pox. The sixth case, a mild one, was that of a nurse who had been re-vaccinated ten years before." Dr. Gayton gives a similar but even more striking instance in connection with the Homerton Small-pox Hospital. The statistics given in connection with the small-pox ship hospitals in connection with the Metropolitan Asylums Board during the twelve years, 1884–1895, are also very conclusive. Amongst the attendants, varying in number from fifty in one year to 300 in another, there have only been three years out of the whole twelve in which cases of small-pox have occurred. In 1884, there were four cases among 283 attendants; in 1892, two cases among 138 attendants; and in 1893, six cases among 230 attendants. These were in close attendance upon small-pox patients in the hospital ship; all had been re-vaccinated, but in six out of the twelve cases where small-pox occurred it developed within fifteen days of admission to the ship, so that the small-pox infection and the introduction of the vaccine matter had taken place at the same time, or, as in at least two cases, the vaccination had been preceded by the small-pox infection. These are most remarkable figures, and offer evidence that well-vaccinated persons may be brought into very close contact with small-pox patients without running more than a minimal risk of contracting the disease; on the other hand, even the most careful isolation cannot prevent the outbreak of small-pox amongst the unvaccinated, unless the isolation takes place before the disease can be actually recognised, the infectivity making itself felt before the disease can be recognised. The report given by Mr. Allanson Picton and Dr. Collins certainly makes out a strong case for isolation and improved sanitation, but nowhere in it, as we have already said, do they put forward any evidence which can be accepted as proving that these are only of secondary value to vaccination during infancy and re-vaccination at stated periods, and we can quite understand how even Mr. Bright and Mr. Whitbread, along with others of the Commissioners, have been brought to see that it is impossible to contemplate the effect of leaving the whole of the population unvaccinated "without the utmost dismay."

(E) "As to whether any alterations should be made in the arrangements and proceedings for securing the performance of vaccinations, and, in particular, in those provisions of the Vaccination Acts with respect to prosecutions for non-compliance with the Law." In this Section we have the crux of the whole question. The course that the Commissioners have taken affords stronger proof of their belief in the efficacy of vaccination than any other recommendation they could have issued. They believe that the case for vaccination is so strong, that when their report is made public, and when people have had time to digest its contents, especially if the stimulus of alleged martyrdom be removed, that much of the opposition to vaccination will disappear, and that, as in Scotland, where proceedings against parents for the non-vaccination of their children are comparatively rare, the opposition to vaccination will gradually be broken down, and compulsory vaccination will no longer be necessary. Going on the principle that failure to comply with the vaccination laws is often the result of carelessness and desire to avoid trouble, although in justification of this carelessness an objection to vaccination may afterwards be developed, the Commissioners suggest that it should be necessary to take at least as much trouble to escape vaccination as to allow the child to be vaccinated. Conscientious objectors are to be allowed to make a declaration before a magistrate; this would be still more effective were it necessary to go before the magistrate in open court. The exact nature of the recommendations of the Commissioners, however, is a matter of very slight importance, as the general impression produced by this report must be overwhelmingly in favour of vaccination; and those who maintain, or rather did maintain, that the Commissioners were of opinion that vaccination was a failure, had either not read the report or had intentionally misunderstood it. As we have pointed out, of those who are against compulsory vaccination, even in the modified form suggested by the majority of the Commissioners, two are still so convinced of its efficacy that they sign the general report; and the other two, although maintaining that isolation and improved sanitary administration are sufficient to cope with the disease, nowhere lay down as a proposition that vaccination affords no protection against small-pox. After a careful perusal of the report we are convinced that, although this Commission has taken seven years during which to sift evidence and make its report, it has, both from the momentous issues at stake, and by the judicious nature of its finding, been thoroughly justified from beginning to end, and that the report will be accepted as one of the best ever presented to our, or to any other, Parliament.

SOME ENGINEERING ADVANCES IN SIXTY YEARS.[1]

WE meet this evening under peculiar circumstances, some of which are of much interest to every member of the empire, and others are specially appertaining to the Institution. These circumstances seem to me to mark the year 1896 as an epoch, at which your President may offer to you some remarks which will be not strictly a review of any of the various recent feats of engineering, but rather a retrospective survey of the general progress with which engineering has been and is intimately connected, and a consideration of some matters past, present, and future, which appear to me to touch closely the interests of us all as members of the profession.

The material advances which this country has made during the Queen's reign are so remarkable, and have depended so

[1] Abstract of the presidential address delivered before the Institution of Civil Engineers on November 3, by Mr. J. Wolfe Barry, C.B., F.R.S.

much on engineering developments and progress, that I think we, as members of that profession, may at such a time as this survey with profit the period covered between the accession in 1837 and the present time from that point of view, and endeavour to recall some of the differences in various circumstances which have so greatly affected the interests of the population.

No one can deny that these years constitute the most important period yet known of engineering, or that the work of engineers during this period has had most far-reaching effects upon the material interests of the inhabitants of these islands, as indeed of the world at large—whether those effects have been produced by improved means of inter-communication by land and sea, of sanitation, or of labour-saving appliances.

The rapid growth of towns has occasioned a demand, especially within the last thirty or forty years, for urban railways, tramways, bridges, subways, improved pavings, and other means for facilitating intercourse between the different districts of our large towns. It has been the cause of a great development of additional sources of water supply, of improved sewerage, of new means of lighting by gas and electricity, and, above all, has necessitated that minute and careful study of the laws of sanitation which has produced most remarkable results on health and longevity.

Although a short time prior to the Queen's accession, the Stockton and Darlington, the Newcastle and Carlisle, the Liverpool and Manchester, and some isolated railways had been opened and worked by locomotives, and several railways had been worked by horses before the introduction of locomotives, none of the main arterial lines had been opened; and it was not till 1837 that the Grand Junction Railway connected Liverpool with Birmingham, nor till 1838 that the London and Birmingham line was completed. The first through line from London to Scotland was not available for traffic till more than ten years after the Queen's accession, and was then dependent on ferries across the estuaries of the Forth and Tay. Practically speaking, therefore, the railway system of these islands, which was many years in advance of other countries, has been developed in the Queen's reign.

At the date of the accession, though an American ship called the *Savannah*, with small auxiliary engines, had crossed the Atlantic in 1819 in about a month, such a voyage, if attempted by vessels entirely or mainly dependent on steam, was considered by high authorities to be a mathematical impossibility. It was further held that no steamer could face the monsoon in the Red Sea, and, practically speaking, steam navigation was looked upon as only suitable for short voyages across the narrow seas, or for river navigation. In 1838 the *Great Western*, of 2300 gross and 1340 registered tonnage, designed by our past Vice-President, I. K. Brunel, demonstrated for the first time the possibility of the establishment of a regular service of steamers across the Atlantic, and the *Great Western* ran regularly between Bristol and New York for many years, the journey occupying about fourteen days. In 1845 the *Great Britain*, of 3443 gross and 2984 registered tonnage, which was the first large ocean-going steamer in the mercantile marine which was built of iron, and to which the screw-propeller was applied, also designed by Brunel, marked a further important step in advance, and she crossed the Atlantic in about twelve days. By 1840, steamers were overcoming even the dreaded monsoon in the Red Sea and Indian Ocean. Nowadays, as every one knows, the journey to New York occupies a little over five days, at an average speed of 21 knots an hour by vessels of 12,000 tons, with engines of 30,000 h.p.

The mining industry, which again is specially an engineering subject, and on which the prosperity of our country mainly depends, has during the Queen's reign made very great strides. In 1854, the total quantity of coal produced was 65 millions of tons, equal to 2·34 tons per head of population, and in 1895 the total quantity had increased to about 200 millions of tons, equal to 4·73 tons per head of population. The increase of production is continuous, and probably points to increased exports as well as to increased consumption in manufactures or traction. This large quantity of 200 millions of tons annually excavated is difficult to realise. If we assume a thickness of coal *in situ* of 6 feet, the total quantity excavated now annually would occupy nearly 21,000 acres, which is equal to twenty-five times the area.

Prior to 1851 there was no submarine cable across the Channel, none to the United States till 1858, nor to India, Australia, or South Africa till 1865, 1872, and 1879 respectively. Nowadays the mileage of submarine cables is 162,000 miles, the capital employed in them is 40 millions, and the total number of foreign and colonial telegrams is about seven millions annually, without reckoning those that are sent by the submarine companies without the intervention of the Post Office.

This brief retrospect gives some idea, however faint and imperfect, of what has been done by engineers during the past sixty years in facilitating inter-communication between individuals in this and other countries, and in the distribution of produce.

Let us now glance shortly at some of the statistics of the work of the sanitary engineer, whose work affects the duration of human life and the enjoyment of health of every individual. The mean death-rate of London for the various decades from 1840 up to 1870, when the main intercepting sewers of the metropolis were brought into use, was 24·4 per thousand. In 1880 it was reduced to 22·5, and it is now 19·5. This reduction of almost five per thousand, which means a saving of life in London alone of 22,000 individuals annually, is very largely due to the work of the sanitary engineer, though, of course, it is also to be partly accounted for by better wages, better organisation, and better medical education.

Though much of the reduction of the death-rate in towns may properly be attributed to improved sewerage, I by no means think that we ought to look to that cause as being of equal importance to an ample supply of good water. In this direction immense progress has been made during the Queen's reign, and it seems almost impossible for us now to conceive London in its condition of 1837, honeycombed with cesspools, and largely supplied with water either from surface wells, or from the Thames at Battersea or Hungerford.

Though gas for lighting was invented and began to be used prior to the accession, its cheapness and universal application to towns and large villages mark another engineering success of the reign of our Queen, and lately its application to heating purposes is a further most important step.

I have spoken of the work of engineers in railway and steamship transport, in the development of postal, telegraphic, and telephonic inter-communication and in sanitation. These indeed are important successes, but what a record there is for our profession in other labour-saving appliances—in the improvements of spinning and weaving machinery, in lace-making, in the working of iron and steel, in the invention and perfecting of hydraulic machinery—the work and success of our valued Past-President, Lord Armstrong. Hydraulic machinery has done such wonders for the use and convenience of man in every department of manufacture and trade, that it is almost impossible to conceive how even the limited amount of work of our forefathers could have been carried on without such convenient means of the transmission of power as the accumulator and high-pressure water afford.

Again, what a field has been occupied and cultivated within even the latter half of our sixty years by the electrical engineer! This subject is full of the greatest interest, but it is sufficient by itself for an address such as this, and I have no doubt it will be fully dealt with by him whom I look forward to welcoming as my successor. I have spoken shortly of telegraphs and telephones, and I can only further allude to and note the great strides already taken in the transmission of electric energy, whether it be used for traction, lighting, heating, actuation of motors, smelting of refractory metals, welding, or for electrolysis, such as in the production of aluminium or in various other branches of trade.

With regard to traction, which is a seductive subject for enlargement, I will only remark that electric traction has now passed through the experimental stages, and may be looked upon as an accomplished idea. Without entering on the question of its universal adaptability for railways in general, we can see that indisputably it is eminently fitted for any underground railway. We have the facts that the South London Railway and the Liverpool Railway have been and are being worked electrically at this moment; that a French railway company have been working a full-sized train for months between Paris and Mans by an electrically actuated locomotive, though the electricity is generated on that same locomotive, and not conveyed by a conductor; that the Baltimore and Ohio Railway Company of America has constructed and worked an electric locomotive weighing about ninety tons, actuated by electricity conveyed to it by a conductor; and that thousands of miles of tramways are worked by the same means. No doubt the application of elec-

tricity to the working of heavy trains under the exigencies of such traffic as the Metropolitan and District Railways will involve some new problems and require much consideration; but for myself I think the time has come for the work to be faced, and I am persuaded that, large as the necessary capital required may be, it will be well spent.

Before leaving the subject of the present developments of electricity, I may draw attention to the work recently inaugurated at Foyers or Loch Ness for the employment of water-power in the production of electricity for the manufacture of aluminium out of bauxite. For the production of aluminium successfully by this process with commercial success, a great deal of power must be available at a cheap rate, and water-power appears to be the only available source for such a purpose. The rainfall in this country, especially on the west coast, provides a most important agent if it can be stored cheaply at a high level, and both these desiderata are possible at Foyers, as also at other sites on the west coast. When we know that the rainfall at such places as Fort William, Ballacludish, Cumberland, and North Wales, varies from 6 feet to 7 feet per annum, and that the configuration of the country renders storage peculiarly easy, we can see that a great future may remain for the use of water-power, not only in the manufacture of aluminium, but also of acetylene and other products which may in the future attain to much importance. At Foyers the working head of water is 350 feet, and the power already developed is 3608 h.p., at an estimated cost per h.p., per annum, which is only 25 per cent. of the cost of steam-power where coal is cheap. Of course this is merely in a humble way what has been done by harnessing Niagara for commercial purposes; but this application of the forces of nature seems to me to have much promise for the future in this country.

Another most interesting subject of contemplation is the work of the engineer as applied directly to domestic life. I suppose that the invention of the lucifer match—not an engineering but chemical achievement—slightly before the beginning of the reign, but brought to mature development within its early years, was perhaps the greatest domestic boon of the century. An old friend of mine (my fishing ghilly) has described to me how, about 1839, he bought, in a then remote part of Scotland, three lucifer matches for sixpence, and exhibited them to his friends and neighbours, who naturally looked upon them with amazement and some amount of distrust as not altogether canny. The instant availability of light and heat was a stride of the greatest importance, and it is impossible to overrate it as a priceless boon for humanity. In the same way three most important home engineering feats, viz. the invention of the sewing-machine, the adaptation of machinery to the manufacture of watches and clocks, and the invention of the safety bicycle, touch and will continue to touch the home life of more individuals directly and intimately than many other engineering developments of the epoch.

Approaching now the circumstances of the present year, I think a subject of special interest at the present moment to engineers is that new departure which has been authorised by Parliament, and which may have an important bearing on the subject of intercommunication to which I have alluded—I mean the Light Railways Act, and what may be called the Auto-Motor Emancipation Act of last session.

I have little doubt that light railways will, in many districts, be of great utility, and I earnestly hope for, and fully expect, at the hands of the Commissioners appointed, a well-considered policy. Much will depend on the inauguration of the system on sound lines. I hold strongly that light railways should in all cases, other than where they will be independent approaches to a port or to a market, be of the same gauge as the standard gauge of the country. The traffic on these lines (with the above exceptions) must be dependent on the trunk or parent line, and in the nature of things will be small in each individual case.

A very important subject for consideration also in connection with the Light Railways Act, and in itself, is the future of auto-motors as applied to the light traffic, whether of goods or passengers, to be accommodated by the proposed light railways; and no engineer can read the accounts of the results attained by auto-motors, or have seen the machines in operation, without recognising their great promise for the future.

The astonishing thing is that, seeing that about the date of the Queen's accession Hancock ran his steam omnibuses regularly between Paddington and the city, and that Gurney and Scott Russell also ran auto-motors commercially about the same time, and that the subject has engaged the attention of engineers from that time to the present, resulting in various most promising auto-motors, it should be reserved for 1895 and 1896 to show so many practical vehicles. One would have thought that the force of invention, backed by public opinion, would have been sufficient before now to have compelled an alteration of the ridiculous regulations of the Acts of Parliament now happily repealed.

Without for one moment decrying the status of the able engineers who exercised their craft prior to 1837, I think it may be said that the Queen's reign has, practically speaking, witnessed the birth of engineering as a profession of a most important character, and with a great future, fulfilling duties of extreme delicacy, and bearing perhaps more responsibility in respect of life and expenditure than is supported by any other calling.

I have enlarged on the subject of the exploits and triumphs of the engineering profession, not in a spirit of boasting, as the representative for the time being of a profession to which I am proud to belong, but with the view of pointing out the dignity of our calling, and the burden laid upon us thereby, as members of this great Institution, of not letting that dignity suffer any loss or disparagement in the years to come.

In connection with the subject of the education of engineers, it is a matter of much interest to us to know what is the instruction given to engineers of other countries, and the guarantees that it has been more or less assimilated by those who are members of kindred institutions. I will only say here that I have made it my business to gain, through our Secretary, much recent information on these points, which were also investigated in 1870 at the request of the President and Council by our Honorary Member, then our Honorary Secretary, Dr. Pole. To enter into these particulars in such an address as this is impossible, and I must content myself by saying that in France, Germany, Austria, Russia, Belgium and Holland, the greatest attention is paid by the State to a strict scientific training, and that the utmost care is taken to see that all candidates for employment as engineers are, so far as education is concerned, thoroughly equipped for the work which may lie before them.

I see no proper way to ensure the same results being attained in this country except through the instrumentality of this body, which is the representative of the profession here; and I venture to think that if this Institution is to retain its present honourable position as the acknowledged head of the engineering profession of Great Britain, and of Greater Britain, we should see that any credentials or degrees conferred by us are based on undoubted qualifications.

BOTANY AT THE BRITISH ASSOCIATION.

AFTER the delivery of the presidential address by Dr. D. H. Scott, F.R.S., an interim report was presented on the method of preserving and displaying botanical museum specimens.

An important new feature at this year's meeting was an address by the Director of the Royal Gardens, Kew, on the geographical distribution of plants. The lecture was primarily intended for those possessing a general interest in botanical science, rather than for specialists. It is hoped that the success of the experiment will lead to a continuance of such addresses at future meetings of the Botanical Section. Another interesting feature was the prominence given to two important subjects which have been matter of discussion and research for some years—the ascent of water in trees, and the problems of cell-division.

Mr. Francis Darwin, F.R.S., in opening the discussion on the former subject, contributed a paper in which the present state of our knowledge of the ascent of water was lucidly set forth, and treated from a critical standpoint. Prof. Marshall Ward discussed several of the questions raised, from a botanical aspect, with special reference to capillarity and imbibition, and particularly the structure of wood. In addition to various botanists, Prof. Fitzgerald and Dr. Joly, of Dublin, took part in the discussion, and dealt with the question mainly from the physical side. It is probable that a fuller account of the discussion will be given in a forthcoming number of the *Annals of Botany*. Mr. Darwin dealt with the subject under two main heads—the *path* of the ascending current in trees, and the *force* which produces the ascent of the water. Attention was called

to the necessity of a complete study of the minute structure of wood in relation to the modern theories. The concluding words of the opening address may be quoted *verbatim*:—"It is at least a hopeful fact for Messrs. Dixon, Joly, and Askenasy that we cannot point to anything in the anatomy of wood which is absolutely inconsistent with their views. Whether we are friends or opponents of Messrs. Dixon, Joly, and Askenasy's theory, the broad facts remain that water has the power of resisting tensile stress, and that this fact must henceforth be a factor in the problem. There are difficulties in the way of our authors' theory, but it is especially deserving of notice that many of these difficulties are equally serious in the case of any theory which excludes the help of the living elements of the wood, and assumes a flow of water in the tracheals. The authors have not only suggested a *vera causa*, but have done so without multiplying difficulties. There is, therefore, a distinct balance in their favour. Huxley, quoting from Goethe, makes use of the expression *thätige Skepsis*. It is a frame of mind highly appropriate to us in the present juncture, if we interpret it to mean a state of doubt whose fruit is activity, and if we translate activity by experiment."

Prof. Vines, F.R.S., drew attention, in the first place, to a paper of his, recently published in the *Annals of Botany*, giving an account of a number of experiments on the suction-force of branches. He had been under the impression that the results obtained were independent of the action of atmospheric pressure—that they were solely indications of tensile stress exerted by the transpiring branch upon the water in the apparatus; but now he had reason to believe that they were, as a matter of fact, affected by the atmospheric pressure. Hence these results are not different in kind from those of other observers, but are comparable with them. The apparatus which he employed is, however, very useful, on account of its sensitiveness and simplicity, for purposes of demonstration.

The observations in question brought out two important facts: (1) that a high suction-force can be developed by branches which have been deprived of their leaves; and (2) that this suction-force is not dependent upon the life of the branch. He then proceeded to give an account of subsequent observations made with dead hazel-branches (pea-sticks), which had been found to develop considerable suction-force amounting, in one case, to 19½ inches of mercury with a stick 18 inches long. He concluded by expressing the opinion that, in recent attempts to explain the mechanism of the transpiration-current, the part played by the "imbibition" of the cell-walls had been underestimated; and urged that what was especially requisite for further advance, is a more complete investigation of the physical properties of a dead piece of stick.

The second discussion, on some current problems connected with cell-division, was opened by Prof. Bretland Farmer, who gave a very complete account of the present position of cell-division problems, before a joint meeting of Sections C and K. In reference to the centrosome question, Prof. Farmer spoke as follows:—

"Few people are agreed as to what its (the centrosome) very nature actually is, and perhaps still fewer as to the part which it plays in the cell. Some regard it as the active agent in bringing about nuclear division, whilst others believe it to be a transient structure, called into existence by the forces which are at work during karyokinesis. The occurrence and behaviour of centrosomes during karyokinesis (nutosis) require a comparative treatment. Whilst it is quite possible that in the cells of some organisms, the centrosome may possess a marked individuality, it does not therefore necessarily follow that it must occur universally, or that it is concerned, as a principal, with the process; and this latter remark applies even to those instances in which it appears most prominently."

Profs. Minot, Zacharias, Hartog, and others, took part in the discussion. An important contribution, bearing directly on this subject, was made by Miss Ethel Sargant in a paper entitled "On the heterotype divisions of *Lilium Martagon*." Her work may be briefly summarised as follows. There are two series of nuclear division in the life-history of *Lilium Martagon*, which exhibit twelve chromosomes in place of twenty-four. The preparations made by Miss Sargant include the whole oögenetic series and the first three divisions of the spermatogenetic series. The second and third divisions in both are precisely similar to vegetative nuclear divisions except in possessing only half the number of chromosomes. They are called *homotype*.

The first nuclear division on either side is called *heterotype*, because the process of karyokinesis differs from that of the vegetative nucleus. Miss Sargant dealt with the distinguishing features of the latter heterotype divisions.

THALLOPHYTA.

Prof. Magnus, of Berlin, gave an account of some recent observations on the Chytridiaceous genus *Urophlyctis*. The author maintained the genus *Urophlyctis*. He described the development of the species *Urophlyctis Kriegeriana*, occurring in *Carum carvi*, established by him some years ago, and showed that its spores are formed by the conjugation of two cells, arising from different filaments, and that the development of the fungus takes place within a single cell of the host, namely, the central cell of the gall produced by it, which is of limited growth. The author proved that the fungus observed by Trabut in Algiers, which causes large swellings on beetroots, also belongs to this genus *Urophlyctis*. Prof. Magnus proved that its spores are likewise formed by the conjugation of two cells, arising from different filaments, exactly as in *Urophlyctis*.

Mr. Vaughan Jennings contributed a note on *Corallorhiza innata*, R.Br., and its associated fungi. Without being able to speak of his conclusions as in all cases definitely established by proof, the author thus summarised his results.

"So far, then, as this district (Davos Platz) is concerned, it seems that the 'mycorhiza' of *Corallorhiza* is a hymenomycete, and commonly an agaric; and that certain species of *Tricholoma* and *Clitocybe* are those commonly observed. The only other forms yet noted in proximity to *Corallorhiza* are *Cortinarius subferrugineus*, Batsch., and *Mycena umbellifera*, Sch., but further evidence with regard to these is at present wanting."

Mr. Vaughan Jennings also gave an account of a form of *Schizomycetes*, for which he proposed the name *Astrobacter Jonesii*.

Mr. Coppen Jones contributed some observations on the so-called tubercle *Bacillus*. He expressed the opinion that there are several considerations which tend to modify our views with respect to its biological status. The facts he brought forward favoured the view that the so-called "tubercle bacillus" is really a stage in the life-history of some higher form of fungus with a definite mycelial growth. From a systematic point of view, it cannot be regarded as coming within any definition of the genus *Bacillus*, and it is suggested that a more appropriate name would be *Tuberculomyces*. Whether the change in our view as to the real nature of the tubercle fungus will in the future be of any diagnostic value it is impossible to say, as comparatively few cases showing the filamentous growth have yet been observed; but there is some evidence in support of the idea that the hyphal type may be correlated with more chronic stages of the disease, where actual tissue destruction is relatively slight.

Mr. W. G. P. Ellis contributed an account of the life-history of a fungus which is the cause of a parasitic disease in the Liverwort *Pellia epiphylla*. A disease appearing on and spreading centrifugally over a pan of *Pellia* was investigated during the summer of 1896. The author was led to regard the fungus as the conidial phase of an Ascomycete, similar to, if not identical with *Ascotricha*, the conidial stage of a *Chætomium*.

Prof. Chodat, of Geneva, communicated an extremely interesting paper of far-reaching importance on the polymorphism of the green algæ, and the principles of their evolution. The green algæ may be divided into two distinct groups, the *Euchlorophyceæ*, and the *Siphoneæ*. In the former a true cell-division takes place, while in the latter the thallus is non-cellular. The starting-point in the evolution of the *Euchlorophyceæ* is very likely the *Palmellaceæ* (including the genera *Tetraspora*, *Palmella*, and *Apiocystis*). Observations show that no clear boundary line can be drawn between the different groups and the *Palmellaceæ*, from which they are supposed to be derived. The *Volvocineæ*, for example, agree very closely with the *Palmellaceæ* in the structure of the cells, but in these the resting stage is only transient. In this non-motile condition obtained by culture, they cannot be distinguished from the latter. In another direction the *Protococcaceæ* can be derived from the *Palmellaceæ* by the prevalence of the sporangial condition. In some species or genera the single-celled sporangium produces zoospores, but in the course of evolution these are replaced by the non-motile spores, when the mother cells or sporangia have a definite form as in *Scenodesmus* and *Raphidium*.

In certain forms of *Pleurococcus vulgaris* a production of zoo-

spores occurs, and in others these are replaced by non-motile spores. In this case, as in others, it is easy to observe that a true difference between the so-called cell division and free cell formation (Al. Braun) does not exist; the latter being only the result of an early or late dissolution of the septa.

The homology of the sexuality of *Coleochæte* with the *Archegoniatæ* is only apparent. In none of the green algæ (*Euchlorophyceæ*) can an archegonium or antheridium be recognised. The genus *Aphanochæte* clearly shows that the affinity of *Coleochæte* is with the *Chlorophyceæ*, and not with the *Archegoniatæ*. A fuller account of Prof. Chodat's paper is to appear in the *Annals of Botany*.

Prof. Zacharias, of Hamburg, gave an account of his researches on the histology of the blue-green algæ. In each cell there is a central colourless portion surrounded by protoplasm containing colouring matter. The protoplasm, when treated with reagents, reveals a spongy structure. In the surface, or occasionally outside the central portion, there occur granules which agree in certain reactions with the chromatin of the nucleus of other organisms. To these granules Zacharias has given the name of "central substance." More recent investigations have made it doubtful whether the central substance contains nuclein like the chromosomes. It is probable that the central body of the spore contains glycogen. In the cell protoplasm there occur granules different from the central substance. Cell-division occurs without the karyokinetic figures.

PTERIDOPHYTA, &C.

A paper of exceptional importance was read by Mr. Lang, on some peculiar cases of apogamous reproduction in ferns.

In order to ascertain to what extent apogamy in *Nephrodium filix-mas*, Desv., is correlated with the cresting of the fern plant, from which the spores were derived, the author made cultures of normal and crested forms. Of the three cultures of normal forms one was unsuccessful; one of the others was exclusively apogamous, while the other reproduced itself in the ordinary way. Seven crested varieties were sown; five of these were apogamous, and the other two normal.

Cultures were also made of crested varieties of other species. In all in which young plants were produced their development was at first normal. After the cultures had continued for nine months young plants, developed apogamously, were found in *Scolopendrium vulgare*, *Athyrium filix fœmina*, and *Aspidium aculeatum*, var. *angulare*.

Unfertilised prothalli of *Scolopendrium vulgare* formed a cylindrical, fleshy prolongation of the midrib, the tip of which became in time covered with ramenta, and was continued directly as the axis of the young sporophyte. Archegonia were present just below the ramenta.

In some prothalli of a fern from Mr. Druery's collection, which was labelled *Lastræa dilatata*, var. *cristato-gracilis*, a similar prolongation of the median region was found. Upon this sporangia were borne, sometimes singly, in other cases grouped together so as to resemble a sorus. The sporangia had a well-developed annulus, which sometimes showed the characteristic reddish-brown thickenings of the wall. The prolongation on which the sporangia were situated bore archegonia and antheridia, which sometimes intervened between two groups of sporangia. Its prothallial nature was, therefore, beyond doubt. The sporangia were borne on prothalli on which no trace of a young sporophyte could be detected.

Prof. Bower, F.R.S., contributed a paper on the enumeration of spore-mother-cells and spores as a basis of comparison of ferns. The author brought out, in a striking manner, some interesting points of comparison between different fern types. He gave in a tabular form the results of computation of the number of spores per sporangium in representatives of various ferns, and also of sporangia and spores per sorus. These brought out distinctly the fact that the potential output per sporangium, as estimated by the number of spore-mother-cells, varies very greatly among Leptosporangiate ferns, being only 16 in *Ceratopteris*, while in *Gleichenia* the number may be about 1400; *Aneimia* and *Osmunda* showing, respectively, about 128, and over 500. The further fact that *Gleichenia* produces an output virtually equivalent to that of *Angiopteris*, is specially interesting as showing that no numerical gulf lies between the Leptosporangiate and Eusporangiate ferns.

Remarks were also made on the parallelism of complexity of sporangia and antheridia in various homosporous Pteridophyta.

After the papers by Prof. Chodat, Prof. Bower, and Mr. Lang had been read, a discussion took place, which had special reference to the general question of alternation of generations in plants, which had been treated at some length by Dr. Scott in his opening address. In reply to arguments advanced by Dr. Scott, and relating especially to the examples of apogamy described by Mr. Lang, Prof. Bower expressed the opinion afresh that both apogamy and apospory are to be looked upon as abnormalities, which are not a proper subject for strict morphological argument; moreover, both are susceptible of a physiological explanation, as substitutionary growths. The argument from apospory, as evidence of homologous alternation, involves the fallacy that parts which, under unusual circumstances, can be induced to undergo similar development are of similar origin.

If such abnormalities as Mr. Lang describes be used for argument, the complete jumble of succession would allow of almost any view. The opinion was expressed by Prof. Bower, on the general question, that neither by the description of these abnormalities, nor by the other arguments advanced by Dr. Scott, is the case for homologous alternation made out. The green algæ can at most be used as examples of how alternation may have originated.

Dr. Scott then replied to Prof. Bower's criticisms.

HIGHER PLANTS; PHYSIOLOGY, ANATOMY, &C.

Prof. Casimir de Candolle, of Geneva, contributed some exceedingly interesting notes on latent life in seeds. The author gave an account of some experiments, recently carried out, on the power of germination of seeds exposed for different periods to a low temperature. He also recorded striking instances of the development of normal seedlings from seeds which had been kept for a great number of years. Robert Brown obtained perfect seedlings from seeds of *Nelumbium speciosum* more than a century old. Plants buried under rubbish heaps collected by the Greeks, have been found to develop and bear flowers from seeds which must have been at least fifteen hundred years old. To test the condition of a dormant seed, M. de Candolle exposed the seeds of several plants to a temperature too low to admit of the continuance of the process of respiration. Seeds of corn, oats, fennel, *Mimosa pudica*, and *Gloxinia*, &c., were exposed for 118 days to a temperature of 40° F. below zero. The experiments were carried on at Liverpool in refrigerating machines, in which during eight hours each day the average temperature recorded was − 40° F., and occasionally far lower. Nearly all the seeds of corn, oat, fennel, and a great many of the *Mimosa* seeds germinated. The conclusion to be drawn from the experiments seems to be, that in resting seeds the protoplasm is not actually living, but has reached a stage of inaction in which, although not dead, it is endowed with potential life. In other words, protoplasm in resting seeds is not analogous to a smouldering fire, but rather to those chemical mixtures made up of bodies capable of combining under certain conditions of temperature and illumination.

Prof. Marshall Ward, Dr. Scott, and others discussed several important points suggested by Prof. de Candolle's paper.

Prof. Trail, F.R.S., gave some account of his recent observations on the floral deviations in some species of *Polygonum*. The genus has long been known to show considerable departures from the arrangement and number of parts accepted as most typical (Per. 5. St. 5 + 3, C. $\frac{3}{3}$), such as is found in *P. convolvulus*.

A comparison of different species shows that while each varies, so as in the more variable species to cover almost the whole range observed in the genus, each shows a tendency to certain lines of variation. These tendencies are more alike usually in the more nearly allied species, so as to correspond in the main with the groups based on habit, and they lead from group to group.

The modes of variation commonly observed include almost all the recognised modes of departure from floral symmetry. They affect all the whorls. The *perianth* in some species is very constant. In others it habitually shows cohesion of two or more segments, or abortion in different degrees, or suppression of one or two (usually the inner) segments. Chorisis of a segment is less frequent. Enations from one or more segments are frequent in certain species, rare or absent in others. The *outer stamens* often show cohesion of the two in each pair, varying from the slightest union of the bases of the filaments to absolute union of even the anthers. Abortion (in all degrees to complete suppression) of one or more stamens is not rare. The *inner stamens* seldom show cohesion (except in *aviculare* and its

allies) with stamens of the outer whorl. Abortion is very frequent, and in certain species (*amphibium*) this whorl has completely disappeared.

Miss Lily Huie contributed some observations on the changes in the tentacle of *Drosera rotundifolia*, produced by feeding with egg albumen.

In unfed leaves fixed in watery picro-corrosive (sp. gr. 1·020) and stained with Eosin-Toluidin blue, the apical and lateral glands of the first or outer layer, and also all the cells of the second or middle layer, show a deep-blue cytoplasm, with nuclei possessing little chromatin proper, but large nucleoli and a granular nucleoplasm. Within one minute after feeding the blue cytoplasm becomes purple; after one hour it is greatly vacuolated and reddish purple; after twenty-four hours the blue material has disappeared, and only a few strands of a pink cytoplasm are to be seen. The nucleus after feeding loses the granular cytoplasm, the nuclear chromatin segments enlarge enormously, reminding one of the early stages of mitosis. The nucleolus has lost its red chromatin, and is not easy to see.

Recuperation of the cytoplasm is the result of nuclear activity, for the chromosomes enlarge during the period preceding the appearance of the granular nucleoplasm, which latter in every respect resembles the granular deposit of cytoplasm in immediate contact with the outer surface of the nuclear membrane.

Dr. Morris, C.M.G., contributed a note on the singular effect produced in certain animals in the West Indies, by feeding on the young shoots, leaves, pods, and seeds of the wild tamarind or Jumbai plant (*Leucæna glauca*, Benth.). The wild tamarind of Jamaica, and the Jumbai or Jumbie of the Bahamas, is commonly found along roadsides and in waste places in tropical America. It presents the appearance of a weedy-looking *Acacia*, and belongs to the tribe *Eumimoseæ* of the N.O. *Leguminosæ*. It occurs in the West Indies, Bahamas, Demerara, Brazil, Peru, gardens of South Europe and North Africa; widely found in tropical Africa, East Indies, Ceylon, Mauritius, Java and China.

The author described the plant as being distinctly encouraged in the Bahamas as a fodder plant. The people were fully aware of the singular effect it produced on horses, and added that it also affected mules and donkeys. Its effect on pigs was still more marked. These animals assumed a completely naked condition, and appeared without a single hair on their body. Horses badly affected by Jumbai were occasionally seen in the streets of Nassau, where they were known as "cigar-tails." Such depilated animals, although apparently healthy, were considerably depreciated in value. They were said to recover when fed exclusively on corn and grass. The effects of the Jumbai on horses, mules, donkeys, and pigs were regarded as accidental—due to neglect or ignorance. The seeds probably contain the deleterious principle in a greater degree than any other part of the plant. The active principle in *Leucæna glauca* has not yet been investigated. There is abundant material at hand for this purpose in almost every part of the world. It is probable that the active principle may consist of a volatile alkaloid somewhat similar to that found in *Lathyrus sativus*.

In *Leucæna glauca* we possess a plant with singular properties. It is a vegetable depilatory of a very decided character. No other plant appears to produce exactly identical results.

Mr. Scott Elliot read a paper on the influence of habitat upon plant-habit. The author gave the results of an attempt to tabulate and compare the habits and habitats of the *Ranunculaceæ*, *Papaveraceæ*, &c., in the Kew and British Museum herbaria. The tables exhibited illustrated the dependence of habit upon habitat in 230 plants. In conclusion the author anticipated the objections of those who hold the original hypothesis of Prof. Weismann (that acquired characters can by no means be inherited), by pointing to the most recent publication of this writer, wherein use inheritance of a kind is admitted.

Dr. Wilson exhibited a series of excellent photographic lantern slides illustrating his numerous experiments on hybridisation in Passion flowers and Albucas. The first paper, on a new hybrid Passion flower, dealt with a cross between *Passiflora Buonapartea* and *P. Cærulea*, the latter being the pollen-parent. The former has a quadrangular winged stem, and the leaves are elliptical in outline; the latter has a cylindrical stem, and the leaves five-lobed. The stem of the hybrid exhibits many intermediate characters, and the leaves are three-lobed. The presence of a group of glands terminating the coronal filaments was shown on the screen. The glands are present in the seed-parent, but not in the pollen parent, and in the hybrid they appear in reduced number.

In a further communication, dealing with observations on hybrid Albucas, Dr. Wilson exhibited a large series of illustrations from nature, showing the effects of hybridisation on the bulbs and flowers of these plants. He described a new species, named by him *A. prolifera*. This species is characterised by producing remarkable lateral outgrowths which carry young bulbs, while it also bears numerous obscurely-stalked basal bulbils.

Mr. Gwynne-Vaughan gave an account of his investigations on the arrangement of the vascular bundles in certain *Nymphæaceæ*.

Mr. Keeble described certain observations on the *Loranthaceæ* of Ceylon, relating to the emergences on the embryo of *Loranthus neelgherensis*, and to the mode of penetration into the host.

FOSSIL PLANTS.

Dr. D. H. Scott, F.R.S., gave an account of some researches on certain Carboniferous fossils referred to *Lepidostrobus*.

Mr. A. C. Seward contributed notes on a large specimen of *Lyginodendron*, based on the examination of specimens in the British Museum. He proposed to designate the species *L. robustum*.

Mr. Seward also gave an account of a new cycad from the Isle of Portland.

Dr. Woodward lately obtained an exceedingly fine specimen of a cycadean stem from the Purbeck beds of Portland, which is now in the fossil plant gallery of the British Museum. The stem, which is probably the largest known, has a height of 1 m. 18·5 cm., and measures 1 m. 7 cm. in girth at the broadest part. A striking feature of the specimen is the conical apical bud enclosed by tapered bud scales, bearing numerous ramental outgrowths on the exposed surface.

REPORT ON TECHNOLOGICAL EXAMINATIONS.

THE Report, just issued, on the work of the Examinations Department of the City and Guilds of London Institute, is a noteworthy document. The functions of this department of the Institute extend beyond those of an ordinary Examining Body. Its efforts have been directed for many years towards encouraging, in different ways, sound technical instruction; and the aim of the Committee has been rather to secure for artisan students systematic teaching, than to increase the number of candidates for examination. Unfortunately, such students are often quite unprepared to receive technical instruction.

Several of the Examiners refer to the defects of the earlier education of the students, and some surprise is expressed that the candidates spell so badly and experience such difficulty in expressing what they know in words. The Examiners in plumbers' work complain that very few of the candidates knew how to work out a simple geometrical problem, and that in those elementary principles of science which underlie plumbers' work, a very small proportion of the candidates appear to have received any adequate instruction. Among engineering apprentices, a large number of candidates appear to have attended science classes; but in the subjects of weaving and spinning, and in most other subjects, the number is very small. The Committee of the Institute have consequently come to the conclusion that the principles of science should be presented to the artisan student in a form bearing more directly upon the trade in which he is engaged, than is possible when the elements of any one branch of science are taught to a large class of students occupied in different pursuits. They have accordingly added to their programme a course of instruction to be taken before certain technical subjects. This difficulty as to inadequate preliminary knowledge is met with all over the country, and is a constant cause of failure in many branches of the work of Technical Education Committees.

Another difficulty widely experienced is to find competent teachers for trade classes. This arises from the combination of qualifications required in such teachers. It is desirable that they should spend sufficient time at their trade to have become skilful workmen; they must have some knowledge of scientific method, besides having received a fairly good general education. The Committee think that facilities in the way of scholarships should be offered by County Councils to intelligent workmen, to

enable them to spend two years at a Central Technical School, in order to acquire the necessary knowledge of scientific principles and some acquaintance with methods of instruction. Whether the "intelligent workman" would afterwards be content to pass his days in the workshop, and his evenings in the class-room, is another story. But however this may be, the intentions of the Committee are good, and we should be sorry to say anything which would tend to depreciate the admirable efforts they are making to improve the condition of technical education in this country. Mr. G. Matthey, the Chairman of the Committee, and Sir Philip Magnus, the Superintendent of the examinations, deserve the thanks of every one interested in the development of our industries for their organisation of knowledge which lies at the root of such developments.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. Glaisher, F.R.S., has been appointed Chairman of the Examiners for the Mathematical Tripos, Part II. of 1897. Mr. J. G. Leathem, fourth wrangler 1894 and Isaac Newton Student in Astronomy, has been elected to a fellowship at St. John's College; and Mr. W. E. Philip, third wrangler in the same year, to a fellowship at Clare College. Mr. W. E. Johnson, of King's College, has been appointed to the University Lectureship in Psychology, vacated by Mr. G. F. Stout, editor of *Mind*.

A COMMITTEE has been appointed to consider the mode in which the grants in aid to science and art schools are distributed, and to report if it is desirable to make any alteration therein. The members consist of the Vice-President of the Committee of Council on Education (Chairman); Mrs. Sidgwick, Sir John F. D. Donnelly, K.C.B., Secretary of the Science and Art Department; Sir H. Roscoe, F.R.S., Mr. G. L. Ryder, H.M. Treasury; Prof. R. C. Jebb, M.P., Mr. W. Armstrong, Director of the National Gallery, Dublin; Captain W. de W. Abney, C.B., F.R.S., Science and Art Department (Secretary).

IT is announced in *Science* that the Chicago Institute of Education has appointed a committee of sixty to develop some feasible plan for carrying on systematic outdoor, or field work, in connection with nature study. The committee held its first meeting on September 19, and a permanent organisation was effected by the election of Mr. Wilbur S. Jackman as President, and Mrs. M. L. T. Baker as Secretary, and the appointment of a number of sub-committees. One of the first works of the committee will be the preparation of maps of the environs of Chicago, which will assist the pupils and teachers of the public schools in a systematic study of the country lying within a convenient radius of the city.

THE sum of £25,000 has now been subscribed for an engineering laboratory at Glasgow University (says *Engineering*), and the same tact and energy which have been displayed in finding the money, will result in an early realisation of the aim of the promoters. The sum of £12,500 was voted out of the Bellahouston Trust Estate, and the remainder has been readily subscribed by engineers and others in the district. Meanwhile a temporary laboratory is to be equipped, two large rooms having been set apart in the main building. This, however, will not even delay the arrangements for the new laboratory. A gas engine of ten horse-power is being presented to the University by the Committee of the Murdock Memorial Fund, and this will commemorate the association of the founder of gas-lighting with James Watt. The testing plant will include a ten-ton machine, with tension, compression, shearing, and bending tackle and an autographic stress-strain recorder, while a melting furnace will be constructed for making alloys.

ABUNDANT evidence of the continued increase in the number of well equipped and properly staffed technical schools throughout the country is afforded by the current number of the *Record of Technical and Secondary Education*, which is published quarterly under the auspices of the National Association for the Promotion of Technical and Secondary Education. A detailed review of the work accomplished in thirteen county boroughs is given; and selected as these are from all parts of the country, they afford an excellent means of judging of the general advance which has taken place since the passing of the Technical Instruction Act of 1890. The photographs of the various departments of the Battersea Polytechnic, and the Victoria Institute, Worcester, show that the plan upon which these new places of instruction are furnished leaves very little to be desired. The editorial notes, with which the publication opens, emphasise the occurrences of special educational interest during the preceding three months, and, together with the article on intermediate education in Wales, they show that the Association has reason to be satisfied with the results of its efforts to improve the knowledge of the workers of this country. Reference is made in the *Record* to the Return recently presented to Parliament, showing that the total income of evening continuation schools in this country amounts to £189,130 3*s*. 1*d*., made up as follows:—Grants by the Education Department, £81,362 3*s*. 4*d*.; grants by the Science and Art Department, £1410 12*s*. 11*d*.; grants by County Councils, £16,440 11*s*. 2*d*.; School Board rates, £58,516 12*s*.; voluntary contributions, £7432 7*s*. 8*d*.; school fees and books, £22,303; endowment, £515 18*s*.; other sources, £1149 14*s*. 4*d*.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, October 30.—Captain Abney, President, in the chair.—Special general meeting.—The Secretary having read a summary of the replies sent by members to a circular which had been addressed to them during the last session, a series of resolutions drawn up by the Council, bearing on the points raised by this circular, were adopted. The chief of these resolutions were to the following effect: (1) That the subscription to the Society be raised to £2 2*s*. (2) That present life-members be invited to voluntarily subscribe £1 1*s*. annually to the funds of the Society, or to compound for this annual contribution. (3) That a guarantee fund be instituted. (4) That in future members of the Society be styled Fellows of the Physical Society of London. In the course of the discussion on these resolutions the President, Secretary, and Treasurer gave an account of the financial position of the Society, and explained that at present each member receives from the Society, in the shape of Proceedings and Abstracts, printed matter which costs the Society more than the amount of the annual subscription. The ordinary science meeting was then held.—A letter was read from Lord Kelvin thanking the Society for the address which the President, on their behalf, had recently presented to him. —Prof. W. Stroud read a paper, by himself and Mr. J. B. Henderson, on a satisfactory method of measuring electrolytic conductivity by means of continuous currents. The method consists in placing a balancing electrolytic cell in the arm of the Wheatstone's Bridge adjacent to the arm containing the chief electrolytic cell, so that the electromotive force of polarisation in the two cells neutralise each other's effect on the galvanometer. The authors find that if the resistance of the arms of the bridge are high (20,000 ohms), and if an E.M.F. of about 30 volts is used in the battery circuit, then the resistance of a solution (of potassium chlorate in their experiments) can be determined to within about one part in two thousand. With a D'Arsonval galvanometer the balancing cell is so efficacious that it is impossible to tell that it is not a metallic resistance that is being measured. Prof. Perry asked if the authors had tested whether the difference in resistance of the two cells was proportional to the difference in length of the liquid columns. Mr. Appleyard said he had found that the resistance of an electrolyte appeared to vary, because in the ordinary arrangement the cell was short circuited through the arms of the bridge. He suggested as a remedy the making and breaking of the circuit by a special key so arranged that, except when taking a reading, the cell is on open circuit. Mr. Blakesley asked if the authors had tried the method in which the resistances are adjusted till, when the battery circuit is broken, there is no immediate change in the galvanometer deflection. It is possible by this method to measure a resistance of between 6000 and 10,000 ohms to within 0·1 per cent. Prof. Ayrton said the method referred to by Mr. Blakesley was the ordinary "false zero" method. In using this method you were working to a continuously altering zero; in Prof. Stroud's method, however, the zero was constant. Mr. Appleyard said he had found the "false zero" method troublesome to use. Prof. Stroud, in reply, said they had not tested the proportionality between the resistance and length, and they had not tried the "false zero" method.—Mr. Appleyard then exhibited a number

of different forms of electrical Trevelyan rockers. The most interesting one consisted of two rods of carbon fixed to a wooden sounding-board, with a third carbon rod lying across the other two, so as to form a microphone. A fairly strong current is passed throught his microphone and through two electromagnets, which act on the prongs of a tuning-fork fixed to the sounding-board. The tuning-fork acts on the microphone, which, by making and breaking the current, keeps the fork in vibration. A cylinder of carbon forming the "knife edge" of a small pendulum, supported on two horizontal carbon rods, kept the pendulum in violent oscillation as long as a current passed from one of the horizontal rods,, through the movable cylinder and out through the other horizontal rod.

PARIS.

Academy of Sciences, October 26.—M. A. Cornu in the chair.—The President announced to the Academy the loss it had sustained by the death of M. Félix Tisserand, Member of the Astronomical Section, and gave a short account of his services to science.—Researches on arabinose, by MM. Berthelot and G. André. The study of the action upon arabinose of water, hydrochloric acid, and phosphoric acid under varying pressures. A continuation of the work already published on glucose, estimations of carbon dioxide, carbon monoxide, formic acid, humic acid, and furfurol being carried out.—Explanation of a note entitled "Cryoscopy of precision," by M. F. M. Raoult. A verbal correction of a previous note.—Observations of the Brooks comet (1889 V.) made at the Observatory of Rio de Janeiro, by M. L. Cruls.—On some linear partial differential equations arising from the theory of surfaces, by M. P. Craig.—On the singularities of the equations of dynamics, by M. Paul Painlevé.—On the distributions of strains in metals subjected to stresses, by M. L. Hartmann. From the hypothesis here developed it is concluded that any solid possessing an elastic limit is necessarily non-isotropic.—On the property of discharging electrified bodies produced in gases by incandescent bodies and by electric sparks, by M. E. Branly. Some remarks on a communication by M. Villari.—On the protection afforded by the lightning conductor at the tower of St. Jacques, by MM. C. Milde and E. Grenet.—On the periodic maxima of spectra, by M. Aymonnet.—Vapour pressure of a substance compressed by a gas which it dissolves; vapour pressure of a solution in general, by M. A. Ponsot. By considering such a mixture in osmotic equilibrium, a general expression is obtained, which includes the case where the gas is insoluble in the liquid, and the case of aqueous saline solutions —Hexamethylene-amine and its nitroso-derivatives, by M. Marcel Delépine. Experiments on the heats of combustion and formation of hexamethyleneamine, its nitrate, and two nitroso derivatives.—On the luciferase of animals and vegetables, by M. R. Dubois. The word "luciferase" is applied to the active agent in the production of light in animals and vegetables. The light does not appear to be the result of a combustion or slow oxidation, although the absorption of oxygen is necessary.—Remarks on the digestive organs and mode of nutrition of *Dermochelys coriacea*, by M. L. Vaillant. The digestive organs of this turtle are much more complex than those in allied species, and lead to the conclusion that digestion is carried out somewhat slowly, probably on vegetable substances.—On the discovery of a bed containing vegetable impressions in the old volcanic débris in the island of Phira (Santorin), by M. A. Lacroix. This fossiliferous layer is small, being but a few decimetres thick, and having an area of some square metres, but the imprints are remarkably well preserved. Amongst the plants identified are *Phœnix dactyliflora*, *Chamœrops humilis*, *Pistacia lentiscus*, and *Olea europea*.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 5.

CHEMICAL SOCIETY, at 8.—The Constitution of Nitrogen Iodide: Dr. F. D. Chattaway.—Note on the Solution and Diffusion of certain Metals in Mercury: Prof. Roberts-Austen, C.B., F.R.S.—Compounds of Metallic Hydroxides with Iodine: J. Rettie.—The Economical Preparation of Hydroxylamine Sulphate; The Reduction of Nitrosulphates; and Amidosulphonic Acid: Dr. E. Divers, F.R.S., and Dr. T. Haga.—The Molecular Conductivity of Amidosulphonic Acid: Joji Sakurai —Physiological Action of Amidosulphonic Acid: Dr. Oscar Loew.—Imidosulphonates. Part II.: Dr. E. Divers, F.R.S., and Dr. T. Haga.—How Mercurous and Mercuric Salts change into each other: Seihachi Hada.—The Effect of Heat on Aqueous Solutions of Chrome Alum: Margaret D. Dougal.—The Saponification of Ethylic Dicarboxyl Glutaconate: Dr. H. W. Bolam.—The Periodic Law: R. M. Deeley.—The Colouring Matters occurring in British Plants: A. G. Perkin.—Carbohydrates of Cereal Straws: C. F. Cross, E. J. Bevan, and Claude Smith.

LINNEAN SOCIETY, at 8.—Mediterranean Bryozoa: A. W. Waters.—On some New Species of Crassula from South Africa: Dr. S. Schönland.—Holothurians of New Zealand: A. H. Dendy.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—Breakdowns of Stationary Steam-Engines: Michael Longridge.

FRIDAY, NOVEMBER 6.

GEOLOGISTS' ASSOCIATION, at 8.—Conversazione and Exhibition of Specimens.

TUESDAY, NOVEMBER 10.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Opening Address: The President.—The Jackson-Harmsworth Expedition and the Story of the Last Year's Work: Arthur Montefiore Brice.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Tower Bridge: Superstructure: G. Cruttwell.—The Machinery of the Tower Bridge: Sam. G. Homfray.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—A New Form of Apparatus for Measuring the Light reflected from Prints: Chapman Jones.—A Theory of the Röntgen Phenomena: Charles E. Benham.

ANTHROPOLOGICAL INSTITUTE, at 8.30.

THURSDAY, NOVEMBER 12.

MATHEMATICAL SOCIETY, at 8.—The Combinatory Analysis: President's Address.—An Essay on the Geometrical Calculus, Part I.: Herr Lasker. —Symbolic Logic: H. MacColl —On a General Integral with some Physical Applications: G. J. Hurst.—On Ratio: Prof. Hill, F.R.S.—On the Geometrical Construction of Models of Cubic Surfaces: W. H. Blythe.—Theory of Vortex Rings: H. S. Carslaw.—Differentiation of Spherical Harmonics: E. G. Gallop.—On the Application of Jacobi's Dynamical Method to the General Problem of Three Bodies: On certain Properties of the Mean Motions and the Secular Accelerations of the Principal Arguments used in the Lunar Theory: Prof. E. W. Brown.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Telephone Trunk Lines: John Gavey.

SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY, at 8.—Notes and Observations on Acidalia marginipunctata and the Early Stages of the Second Brood of Polyommatus argiolus: R. Adkin.

FRIDAY, NOVEMBER 13.

PHYSICAL SOCIETY, at 5.—On Röntgen Rays: Prof. Threlfall and Mr. Pollock.—The Absorption of Electric Waves along Wires by a Terminal Bridge: Dr. Barton and Mr. Bryan.

ROYAL ASTRONOMICAL SOCIETY, at 8.

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